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ABSTRACT

Noting that this digest is only an indication of trends, not a detailed analysis, this report summarizes information on computer applications in primary and secondary education, including technical and vocational training, in 43 countries. The information was obtained from surveys made for differing purposes, monographs produced for various bodies, and reports prepared for meetings and conferences. The summary reviews the subject under two main headings: project policies and their economic considerations, and their educational significance. The first section discusses the existence and content of national policies on informatics, the institutional arrangements set up as a result of the policies, and the financial and technological investments that have been made. The second section deals with types of computer applications at the various educational levels, software and teacher training, and attempts to identify trends for each level of education--primary, secondary, technical, vocational, higher education, and informal education. The range of research activities reported is summarized under six headings: (1) Logo applications; (2) computers in special education; (3) general educational research; (4) subject teaching; (5) language teaching; and (6) computer processing of national languages. The third section, which constitutes over half of the report, presents summaries of data for the 43 countries studied, including data on the school population, educational budget, structure of the educational system, computer policies, computer applications, and research activities of each country. (DJR)

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Informatics and Education

A first survey of the state of the art in 43 countries

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EDUCATION AND NEW INFORMATION TECHNOLOGIES

Summary

This summary is based on the information given by country in the body of this document.

The information comes from many different sources (surveys made for differing purposes, monographs produced for various bodies and reports prepared for meetings at conferences) and this digest can only be regarded as an indication of trends, not a detailed analysis of the situation in the countries concerned.

The summary looks at the situation in only 43 countries (out of the 50 for which data summaries are presented), that is to say only those countries for which information was available on computer applications in primary and secondary education - including technical and vocational training.

The summary reviews the subject under two main headings: firstly project policies and their economic considerations and secondly their educational significance.

The first part deals with information about the existence and content of informatics policies (in the light of the industrial context in which they are applied when known), the institutional arrangements set up and the financial and technological investment made.

The second part deals with the types of application that are listed (arranged by educational level) and the answers found to software and teacher training problems.

I. POLICIES AND ECONOMIC CONSIDERATIONS

For about one quarter of the countries under review, the measures regading the introduction of informatics in education date back to the 70s. For the most part the countries belong to the West and the Far East.

Most of the measures taken originally by the authorities and the "spontaneous" events which occurred in the educational world were of an experimental nature and reflect two types of concern: those of an educational nature (changes in the teaching process) and those of an economic nature (the teaching of computer science in response to the requirements of the production sector).

The more structured national policies or schemes generally developed out of the experimentation or partial measures taken at the outset, with the exception of Denmark where there is no definite plan although various recommendations and measures came in between 1970 and 1984.

In every case the early 80s were a turning point in the programmes of those countries which had them, due to the arrival on the market of microcomputers at increasingly low cost, and in the awareness of the information technology phenomenon on the part of the authorities, due largely to the penetration of the new information processing technologies in all fields of society and to economic pressures.

A backward glance over the last 15 years shows a recent acceleration in the changes taking place in most countries. In some cases reports brought out at less than a year's interval show major quantitative and qualitative changes occurring at such a pace as to make any updating of this inventory very difficult. The cases referred to in this summary, therefore, can do no more than illustrate possible measures or innovations. Changes are clearly going to continue with developments in technology, economic conditions and pressures from the communities.

Policies

The concern to define policies or national programmes is found in all countries with the exception of El Salvador, the Dominican Republic, Italy and Denmark which - as we have seen - intended to but then gave up.

Countries like China and Kenya say a policy is necessary but have not so far taken measures accordingly.

In general, therefore, this stated concern is far from being reflected in every case by the formulation of concrete policies or programmes. There are considerable differences from one country to the next in the level of policy decision-making, the effects of these decisions on the educational world, the objectives pursued, the nature and scale of the measures taken and the importance of the changes they involve in educational systems.

Before tackling the more specific question of informatics policies two remarks are called for:

- Local initiatives (taken by certain teachers, groups of teachers, schools, local communities, etc.) and private initiatives (by clubs, associations, professional organisations, the tertiary sector, etc.) have often preceded the education authorities' giving their attention to the computer phenomenon. This applies in many countries with a highly decentralised administration and those where private education is strongly placed.

- Educational problems are on such a scale in some countries (India) or groups of countries (Latin America for example) that informatics can only come low down the table of educational priorities in contexts where school attendance and literacy are prime objectives. The lack of resources rules out any massive introduction of computers in schools in the short term and the taking of any measures other than experimental as will later be seen.

Another point to note is that, in many countries, the number of computers in use (all applications lumped together) is far lower than the number of schools. This indicator alone measures the inability of education systems to absorb the new information technologies. Efforts on a varying scale, however, are everywhere being made at different levels.

National informatics policies

In 65% of the countries in the sample mention is explicitly made of the existence of a national informatics policy.

In all case, these national policies include parallel provisions for the educational sector except for the Ivory Coast where the national informatics plan defined for the period 1981-1985 is unaccompanied by any educational measures.

In some non-industrialised countries - though this also applies to France where national production covers only 25% of the domestic market - the development of the country's computer sector is regarded as a major policy objective. The fact is - and this applies to most Latin American countries - the development of informatics is regarded not simply as a cultural problem but also - and primarily - as a strategic one.

Whether it is a question of helping to put the national development plan into effect (as in India) or bringing about the reconquest or better coverage of the domestic market, the objectives set are to create conditions for the country's growing industrial independence. One of the priorities then is to substitute national production for imports. This applies in India, Argentina, Brazil, Mexico, Cuba, Chile, Hungary and the Ivory Coast, for example. Meaures in favour of the technological independence aimed at are many and varied and generally have an economic aspect (mechanisms to encourage industrial creativity, public financing of research, reform of customs tariff policy, controls on foreign investment, etc.) and a cultural aspect (training of the manpower resources of the quantity and quality necessary for informatics development).

Thus some educational policies hinge directly on industrial and economic development policies. In addition to the countries already referred to this applies in Spain, Japan, the Netherlands, FRG, the United Kingdom, Singapore, Sri-Lanka and USSR.

For other countries (particularly the highly industrialised countries and some Western and Northern European countries) the causal relations between economic development and educational policies are less pronounced and the measures taken less directly rooted in national policy projects.

Institutional arrangements

In most countries where national informatics policies have been defined, ad hoc bodies have been set up, generally close to the head of the state, to define policy orientations and to co-ordinate their implementation. Depending on the case, their role is one of encouragement and/or control. Argentina has set up a National Informatics Commission, Brazil a Special Informatics Secretariat, Singapore a Committee for National Computerization, Sri-Lanka a Computer and Information Technology Council, Mexico a Directorate-General for Informatics Policy and Colombia a National Informatics Council to draw up a master plan for the country's computer development.

Very often, when ministries of education are themselves the implementing agent for national policies, they have set up specific bodies such as the National Centre for Informatics Education in Argentina, the National Advisory Committee for Computers in Schools in Australia, the School Micro-Electronics Programme Committee in Sri-Lanka, the Centre for Education and Information Technology in the Netherlands and the Computer in the Service of Education network in Belgium.

These ministerial bodies are generally responsible for co-ordinating action embarked upon at the different levels: equipment programmes, curricula, teacher training, monitoring of experiments, etc.

In the many countries that have sectoral programmes (whether experimental or national) for specific parts of the school population, in the absence of ad hoc bodies it is the ministry of education directorate responsible for the level of education concerned that supervises project implementation. In federal states, the responsibility is often left to the local community, local education authority or professional organisations.

It has to be noted, all the same, that in many countries that have opted for sectoral policies - and all the more so in all those that apply national policies - projects are often defined in an interministerial framework involving representatives of the various (technical, economic and educational) sectors concerned. In addition, the national universities are often called in and made responsible for research projects or production in some cases and also the training of teachers. The links built up with other technical ministries during project planning are often kept alive in the implementation phases (collaboration with, in particular, ministries for industry, economics and telecommunications).

General versus sectoral policies

Generally speaking, however, this is only the case when national measures are taken, in other words when the projects concern a large part of the educational system, a situation in which only one half of the countries in the sample concerned is to be found.

The figure on the last page of this summary can be consultedd in two ways: reading down the columns shows what levels of the educational systems are involved in the measures taken by the authorities and reading across the columns reveals those counties where the measures taken concern several levels of education at once. Each of the three columns is split into two and a distinction made between exprimental or pilot measures affecting a restricted number of schools and general measures covering a large part (or eventually all) of the level concerned.

Two comments immediately come to mind:

- Measures taken in the largest number of countries apply to secondary education.

- "Global" policies covering several educational levels are rare and the greater the number of schools the rarer they are.

Global policies at the national level covering - at least in intention if not in fact - the whole of the primary and secondary levels exist in Australia, Spain (ATENEA project), Korea, certain Canadian provinces (Ontario and Quebec in particular), France ("Informatics for All" scheme) and the United Kingdom (the Micro-Electronics Education Programme and Scottish Microelectronics Development Programme - MEP and SMDP). A similar policy is on the drawing board in Mexico.

The situation in the United States is rather special in that the generalised introduction of computers in the educational system has taken place without any concerted measures to that end at central level.

It is also interesting to note that global policies are not confined to countries with highly centralised administrations (France for example) because they are also applied in a fairly similar way in decentralised systems such as those in the United Kingdom and Australia.

For all these countries, informatics policies generally have a twofold objective:

(i) An educational objective, i.e. to test and develop the use of the computer as an educational aid (in improving the learning process and teaching methods).

(ii) A cultural objective generally grafted onto the more broader project of modernising the production base: i.e. to prepare children for technological change by developing a scientific and technical culture in the community.

These objectives are missing in the case of Korea, however, where priority is given to the teaching of informatics at all educational levels.

It also has to be noted that, however broad they may be in their principle, the measures taken by the authorities have an unequal impact on the various educational levels. Priority is generally given to secondary education - and often just the second cycle of secondary education - and the innovation then spreads downwards by phases, witness the differences found in the equipment ratios of school establishments and the scale of investment applied to the different levels. In the United Kingdom, for example, the MEP scheme was originally applied in 1980 to secondary education and has gradually spread to the lower levels up to 1985. The same process occurred in France where the "Informatics for All" programme is the only one that really takes primary education into account and then only very partially. The same applies to New Zealand which has the same goals and where the authorities are concentrating their efforts on secondary education.

A common feature of these global policies - at least in the case of Australia, Canada, the United Kingdom and France - is that the measures they comprise relate to what are generally considered to be the four keypoints in introducing informatics in educational systems: equipment, curricula, software and teacher training. Provisions in the policy in preparation in Mexico cover all these sectors. Other countries with a more sectoral policy concerning only secondary education for example, like the Netherlands and Hungary, are also developing measures in these various fields.

In those countries where the policies have a vocational purpose (training of qualified manpower in response to the production sector's requirements) priority is given to measures in the field of equipment and curricula. This is true of most countries in Northern Europe.

All the other countries seem to take measures privileging only one or other of these key sectors. The software sector seems to be the least favoured in terms of the attention given it by the authorities and, in economic terms, a paradoxical situation to the extent that the countries that have made efforts to produce hardware all deplore the lack of software or its unsuitability to the local educational context.

Economic aspects

The main obstacle to the introduction - or development - of informatics in education, however, is its economics, the lack of resources prohibiting this kind of investment in some countries and restricting it, in others, to experimental and one-off applications. Lastly there are many cases where the number of machines in schools is too small for all the applications to which, in principle, they lend themselves to be given effect.

Very little quantitative information is available about the scale of the investment made in countries that have implemented national or experimental projects. Rather than absolute figures, inherently non-comparable because they relate to different scales (school populations, schools, size of teaching staff), it would be interesting to have information about the relative scale of itemised investment. For the Netherlands, for example, it can be seen that 65% of investment goes to equipping schools with hardware, 15% to software production and 15% to teacher training. The approximations it is possible to make for Hungary, France and Canada confirm this tendency for hardware costs to be much higher than the cost of curricula and training, the ratio being about 4 to 1.

Equipment

Relatively accurate figures are available for only about half the countries in the sample. For those that have chosen to act primarily at the secondary level, the average equipment ratio may be estimated at about 70% of schools. When policies embrace primary education as well the ratio for this level is 30%.

Where the policies are sectoral, however, and the effort is concentrated on technical and vocational education as in the case of the Northern European countries (Norway, Denmark, Finland and also Austria), equipment requirements seem more easily satisfied because all the school establishments concerned are equipped.

In all the other cases, where pilot or experimental projects are involved, these concern only a few dozen schools. In some areas like Latin America where these, in practice, are the only projects there are (except for Mexico which is planning to introduce a national policy) the equipment ratio is put at 1% of all (primary and secondary) schools.

Dwelling for a moment on the situation in secondary education, it can be seen that, except for countries that have taken measures for the whole of the cycle (United Kingdom, New Zealand, Austria, Hungary and Australia for example where equipment ratios vary between 90 and 100%), there is a fairly sharp differentiation between the equipment of terminal classes (second cycle) and that of first cycle classes. This fits in with the fact as has already been mentioned that informatics first penetrated this level of education before spreading to the lower age groups and that its introduction in educational systems was very often a matter of serving vocational purposes (training of children for their entry into active life) or the need for preparation for higher education. The difference in equipment ratios between first and second cycles of secondary education varies by a factor of about 1 to 5 in those countries where this point applies (Norway, France and Denmark for example).

Where applications have been extended to primary education the gap between equipment in primary and secondary widens to a ratio of about 1 to 7.

Average equipment ratios cannot form the only indicators of the penetration of informatics in educational systems. They need to be weighted by other factors such as the number of machines present in equipped schools and the number of pupils with access to them. Because of the relative vagueness of national data, both are difficult to estimate. However it would seem that the ratio of students to the number of computers they have access to is very high.

Even in the countries with national policies, the number of computers in use in schools is in the thousands, or tens of thousands at best, compared with theoretical school populations generally running into hundreds of thousands. A good illustration of this situation is France where efforts made under the national equipment scheme have resulted in schools being equipped with 160,000 machines whereas the ideal configurations defined in an earlier phase of computerisation policy (one terminal for 8 pupils) set requirements in the neighbourhood of 1,500,000 terminals. The average at the moment is 1 machine for 50 pupils (1 for 256 in Hungary).

The ratio is still very high even in the best-equipped countries: 92 pupils per terminal in 1984 in the United States (the forecast for 1987 is 23 to 1) and 87 pupils per terminal in Canada (the forecast for 1986 is 46 per terminal).

These national averages, however, give an imperfect picture of the situation. The schools are not generally equipped to the same extent. Beyond the minimum coverage of one computer per school, the authorities seem generally to favour the equipment of certain categories of school and to give them the means to acquire a greater number of computers. In countries where establishments are partly or fully dependent as regards the hardware they have, the gaps are even wider. The same differences are to be noted between public and private schools the latter being generally better equipped. This applies in Latin America, Japan, the United States and Kenya for example. Spain is an example of the reverse because there, schools in the public sector are better equipped than private schools.

The very high ratio of number of pupils to number of computers obviously has educational implications which will be considered later.

For all countries with national policies, the average configuration is 5 microcomputers per equipped school (although the number may vary from 5 to 10 in the United Kingdom, for example, or 1 to 30 in Sweden). Although the evidence is rare, there seems to be a trend towards "computer laboratory" configurations with all the electronic hardware grouped together in the same room and possibly inter-connected. This applies to most projects in Latin America, the USSR, Luxemburg and France where the "Informatics for All" scheme makes explicit provision for the supply of compatible computer set-ups.

In cases where computers in education policies are hitched to forceful policies for the development of the electronics industry for which they are intended as a support, the choice of hardware naturally gives priority, if not exclusivity, to the models offered by domestic producers. The United Kingdom, the Netherlands, USSR, Japan and France have adopted measures of this kind. Some countries offer schools a narrow range consisting of one domestically produced plus 1-3 imported computers. This is true of Hungary, Sweden and the province of Ontario. It is interesting to note that in all three cases (the only ones in the sample concerned), the national computer offered is specially designed, in response to invitations to tender from the ministries of education, for educational applications: the "School computer" produced in 1982 by the Telecommunications Co-operative in Hungary, the computer used in

the framework of the "PRODIS" pilot project for the definition of functional hardware and software specifications for secondary schools in Sweden and the specialised "ICON" computer marketed since 1984 in Ontario.

Some other countries, like Finland and Australia, are trying to reduce the variety of hardware installed in schools by issuing recommendations for or promoting specific types of machine (IBM-PC compatible in New Brunswick for example) or makes (Apple in British Columbia).

Lastly, where there is no restriction on schools as regards the type of computer they choose and where the range of available hardware is large, some countries (Spain, the United Kingdom and Austria) recommend the adoption of the same operating system - depending on machine capacity, CP/M or MS/DOS.

These attempts at relative standardisation are in most cases accompanied by incentives for the purchase of equipment, public grants for the acquisition of recommended computers ranging from 50% of the cost (in the United Kingdom at the start of the MEP programme, Finland and some Australian states) to 75% for the ICON in Ontario.

In pilot projects (except for those operated by private establishments) and national equipment schemes (the Netherlands, Luxembourg, USSR, France and Austria, for example), equipment costs are generally borne by the authorities. Where this involves the local authorities - and this is often the case - the ministries sometimes offer selective assistance with the object of facilitating the equipment of certain schools judged to merit priority in computerisation policy. This applies to technical and vocational education which enjoys a public subsidy of 11% in Finland and 35-75% in Norway.

But in general, the sources of finance for school equipment are extremely varied depending very little on central government budgets. Apart from the school authorites (regional or local government), funds come from teachers, parents' associations and sometimes the pupils themselves, bilateral and multilateral aid organisations, hardware manufacturers, foundations, private firms, etc. This diversity in sources of finance and the absence of standardisation naturally lead to considerable disparities within national computer stocks which inevitably has an impact on the production and distribution of software.

Very little information is available about the logistic support provided for schools and their equipment. As regards acquisition, some countries endeavour to reduce costs by bulk purchasing procedures (Ireland) or by setting up central purchasing houses (province of Alberta in Canada), municipal school districts or state bodies like the "Minnesota Educational Computing Consortium" in the United States).

Finally, some countries refer to the difficulties they have with regard to computer maintenance (Latin America) but do not say what solutions are applied. Clearly the problem becomes increasingly accute as the geographical area over which schools are scattered becomes greater (Australia) and general technical infrastructures more rare (India).

II. EDUCATIONAL ASPECTS

This chapter endeavours to deal, in turn, with questions concerning types of computer application, software and teacher training, and tries to identify trends for each level of education. A note on research trends concludes the section although information collected in this field is scarce.

Primary

Although computers are frequently demanded for (and often by) classes in secondary school, open misgivings are voiced about its introduction into primary school. These generally come from parents, teachers' unions and the authorities, the former being opposed to the use of computers in class and the latter taking the deliberate decision not to have any projects at this level. This applies in the Netherlands, some Canadian provinces and Sweden, for example.

Thus, on top of the economic considerations explaining the low equipment ratio in primary schools, there are educational psychology factors that help to explain the low degree of applications at this level.

In combination, these facts create a situation characterised by the experimental or pilot nature of the projects pursued or their confinement to private schools (Argentina, Brazil and Kenya). A glance at the figure at the end of the summary shows that experimental measures are more numerous, in relation to the measures of a general order taken by the authorities, in primary schools (60% of all projects listed) than in the secondary where pilot projects represent only 40% of all projects.

Some countries limit applications to classes where children have fallen behind and have learning difficulties or to the special education sector. Examples are some Canadian provinces, Belgium, the Netherlands and Finland.

For most countries reporting developments in primary education, the range of applications is very wide particularly in the English-speaking countries: the United Kingdom, Australia, Canada and the United States.

The most frequent use made of computers in primary schools is for teaching mathematics, science and language (drill and practice). However, because of the lack of suitable software, the limited number of computers available in schools and sometimes the reluctance of teachers, some countries are gradually giving up CAI applications and teaching data processing instead using utility software (word processing, file management, databases and tabulators). Typical cases are Australia, Canada and the United Kingdom. Some simulation applications are also found (Japan and Australia) as is the use of games (Kenya and the United States).

In addition, many of the activities proposed centre on cognitive development and problem-solving. These help towards the development and spread of computer literacy by familiarising children with the basic concepts involved and are generally taught in the framework of other disciplines which they supplement (particularly in the case of mathematics). The Logo activities come under this heading. Usually conducted on an experimental basis, these activities often fall within the framework of research programmes although they are formally part of curricula in three Canadian provinces. The countries where this type of activity is being developed include the Netherlands, Senegal, Brazil, France, Australia, Canada and the United States.

Generally speaking, and because of the relative imprecision of informatics policies in primary education, computer science as a subject or its possible applications rarely seems to appear in curricula at this level. It would seem to be the case only in Korea and British Columbia (teaching of computer science) and in Mexico where a 5-year project aims at the general use of CAI as a teaching aid at primary level.

A last point is that the measures taken in primary education rarely slot into an educational continuum leading up to an intensification or extension, at secondary level, of the activities proposed even in those rare cases where global informatics policies embracing both levels have been defined.

Secondary

As noted with regard to equipment, the penetration of computers in secondary education is greater at second cycle level: 60% of applications specifically concern this level.

Five countries (Switzerland, Thailand, Sri-Lanka, Austria and Uruguay) report a complete absence of projects in the first cycle. For the dozen countries referring to applications in the first cycle, these are experimental projects in practically every case or initiatives taken by certain establishments without any really concerted action at central government level (with the exception, of course, of the countrywide schemes introduced in France and the United Kingdom, for example).

A clear majority of the often isolated or spontaneous measures taken in the first cycle are by way of introducing pupils to computer science. Under different names (initiation, familiarisation or computer literacy), courses are given on a varyingly wide, but often optional basis. Whether the instruction is given in lessons on mathematics, the physical sciences or social studies, the object is to develop the technical and social mastery of information processing equipment. As regards the technical side, the dividing line between initiation to and teaching of computer science is rarely clear, curriculum content ranging from the teaching of rudiments and basic concepts to that of simple languages. Courses at these different levels of technical complexity are offered in Sweden, Norway, New Zealand, the Netherlands, Denmark, Finland, China, Japan, USSR, FRG and France.

These activities are not included in school curricula in some countries and only accessible to pupils via non-school activities (as in China) or clubs as in Finland or Singapore. In this specific case, although outside formal education, computer activities are relatively widespread because there are over 130 clubs attended by 13,000 pupils (about 8% of the secondary school population) and planned enlargements should enable this figure to rise to 20%.

In France and Denmark, the concern is to focus effort at this level of education on pupils in difficulty and special education. In this case, computers are used for CAI but this type of application seems rare at the first cycle as only Japan - apart from the two countries whose names have just been quoted - refers to it.

In some countries like the United Kingdom where teaching concentrates on mastering the learning process rather than on content, the use of utilitarian programs for information management is preferred to CAI. Already present in the approach to informatics at primary level, this concern is also to be found in the second cycle of secondary education.

The general conclusion is that CAI applications in secondary schools are not widespread (one quarter of the countries in the sample refer to it) whereas computer science teaching as a subject in its own right or the prolongation of other subjects takes a larger place (over half the projects). No measure seems to have been taken for the exclusive use of computers as a teaching tool, in other words CAI applications are developed as an extra in contexts which also (if not primarily) provide for the teaching of informatics. Conversely, the teaching of computer science as a subject is - in an equal number of cases - the only approach to the new information technologies in secondary establishments. From this standpoint, there would seem to be a step back in CAI applications compared with the situation towards the end of the 70s. Among the explanatory factors for the little use made of computers in CAI contexts is the limited number of computers in schools, the pressure of economic and industrial quarters and the labour market (demand for new qualifications which forces the authorities to give priority to computer science teaching) and doubtlessly, also, the opposition of teachers who are not ready to adopt the new methods.

However this may be, where they exist CAI applications generally extend to all subjects taught but with some measure of concentration on scientific subjects. This type of application, however often comes second to the teaching of computer science (only one third of machine use time in the United States and Spain, for example) and continues to be the subject of research, as will be seen later on, or research in action, e.g. in Mexico where the development plan makes provision for a prior experimentation phase relating to both the teaching of informatics and CAI. Experience in this experimental phase makes it possible to observe both the conditions in which computer science is taught or used in the teaching of other subjects and the reciprocal effects of the one upon the other.

As in the first cycle, the dividing line is difficult to draw between initiation to and training in computer science. In Sweden, New Zealand and Canada these activities are an extension of the activities offered in the first cycle. For three countries (Sri-Lanka, India and Trinidad) they are the subject of experimental projects, that launched in 1983 in Sri-Lanka being intended to familiarise pupils with the use of microcomputers by means of school lessons and club activities, the programmes for which are partly based on those developed in the United Kingdom. In its first phase, the project concerned 108 second cycle scientific education establishments and in its final phase, if the extension is agreed, it should rope in 1,500 schools and 200,000 pupils, i.e. 6% of the total school population. In India the CLASS project (Computer Literacy and Awareness in Secondary Schools) was launched by government decision in 1984. As in Sri-Lanka, its objectives are to familiarise children with computers and computer applications in daily and working life but also to encourage teachers to use computers to improve the effectiveness of their teaching. The project involves 250 schools across all the states. Although the school curricula differ from state to state, a uniform programme has been defined, mainly targeted at problem-solving using programming-simulation software. In Trinidad, via the Higher National Institute for Scientific and Technical Research, the Ministry of Education defined an experimental Introduction to computers project in 1983 which involves some 30 schools and is currently being evaluated.

The situation with regard to the teaching of informatics varies from country to country and sometimes even from one school district to the next within the same country. Restricted in some cases to a few establishments (Thailand and Cuba) or to private education (as frequently happens in America), computer science is an optional subject in most cases generally as part of the teaching of scientific disciplines (mathematics, physics and technology). In some countries (FRG and Austria) it may be an optional subject for the general secondary school leaving examination. In others, it is compulsory in some schools (Switzerand) or some states (USA) and more rarely across the board (in Finland).

Little information is available on the changes made to curricula because of this new teaching method. In Latin America the teaching of informatics is not generally written into official curricula but Ontario has a specific curriculum entitled Computer Studies and every country is a case on its on in this respect.

The duration of courses also seems to vary greatly from one country to another (ranging from a few to over 300 hours a year) the only observable general tendency being for the number of hours to increase with age of class.

Information is also scarce about the content of the courses themselves and the general lines followed in computer science. It would seem, however, that several countries are increasingly teaching programming though often limiting this to the learning of computer languages (Basic, Fortran, Prolog, etc.) in other words cultivating knowledge that the speed of technological progress could easily render obsolete at an early date instead of concentrating on the understanding of computers and the development of the conceptual tools necessary for their use. In a way, this places limits on the capacity of the educational system to respond effectively to the requirements of the production sector as in Japan, for example, where firms consider that the types and levels of training offered by school establishments do not match what they need and prefer to be themselves responsible for the computer training of their staff. Other countries, however, manage to respond to market requirements by training given in technical and vocational schools.

Technical and vocational education

This sector, on-line as it were to the requirements of the manpower market, is often, indeed, the sector of the education system where the computer has really penetrated. It has already been seen that national policies have often made it a central priority which explains why measures taken with regard to equipment have given it preference over the other levels.

In Northern Europe, for example, computer science has penetrated not just the specialised streams but often every part of technical and vocational education (Finland, Austria, Norway, the Netherlands and Belgium in particular). Beyond the teaching of informatics itself, data processing is frequently included in all basic subjects in various forms: CAI, use of databases, utility programs, simulation, etc. This is the case in Switzerland, Austria, FRG, the Netherlands and Finland.

Higher education

Most of the documents collected for producing this inventory have many allusions to computer applications in higher education. Information about the teaching of computer science - the traditional responsibility of higher education establishments - has not been considered but only those cases of the use of the computer as a tool for teaching/learning and data management.

The main applications are as follows:

- Computer assisted instruction - in USA where the development of the PLATO system helped considerably to broaden the use of this form of teaching, in Paraguay, in Japan where projects are studying the use of computer-piloted videodiscs in this context (a type of use that is also very frequent in the United States), in Chili (pharmacy and medicine), in Argentina for the teaching of the basic sciences and technological disciplines in the specialised chemical engineering course at the National University of the Seaboard, in Brazil and finally in USSR where, alongside generalised CAI applications, projects are being developed for the development of systems which integrate evaluation procedures in the learning process (ASTRA system developed by the Moscow Electronics Institute).

- Evaluation and knowledge testing - in USSR where the same Institute has designed the AKKORD system for testing learning in all disciplines, in Paraguay and in Mexico where the Higher Studies Technological Institute in Monterey has developed a system for statistics and dynamics examinations and set up a computer-based evaluation centre for the learning of mathematics.

- Simulation and games - in Latin America and in USSR in the economics and engineering sciences streams.

- Graphics - in Mexico (training in technical design), training in computer-assisted manufacturing techniques (CAM) and in many architectural schools and in Chile (chemical engineering).

- Documentation processing and databases - in Spain, where the national plan for informatics in science is explicitly aimed at consolidating the information management infrastructures for the scientific community and in Japan and other countries producing databases.

Informal education

The ways in which informatics has been fed into informal education (outside the school system) are very varied and bear witness, if this were still needed, of the social phenomenon that information technology, like other technologies before it, constitutes in practically all parts of the world.

Apart from the action taken directly by hardware producers (particularly active in the training field), action by the authorities and private bodies takes the following forms:

- The organisation of introductory or training courses for the general public: in Singapore where these are offered (to over 30,000 people) by associations like the People's Association, the National Trade Union Congress and the Army Reservists Association, in Sri-Lanka where this responsibility is assumed by the universities, in Colombia where the Latin-American Informatics Centre has opened a network of 17 urban centres for the diffusion of informatics and several community centres in rural areas with free access and working in conjunction with the schools, in Hungary where Houses of Culture are equipped with the same hardware as schools in order to enable them to cater for adults and, finally, in France where efforts have been made aimed at the young unemployed by Informatics Training Volunteers in the framework of their national service.

- The training is sometimes given by distance education (Open University in Great Britain) or via the television: programmes planned in Sri-Lanka and regularly broadcast in France, Hungary (Tele-Basic) and the Philippines.

- The idea in India is to have mobile units travelling across the country to make up for the shortage of information and training structures and of qualified instructors.

- It may be temporary, organised in the form of computer summer camps as in Hungary.

- There are also permanent structures - computer rooms or clubs - arising out of community initiatives as in Sri-Lanka and the Philippines, founded by user associations as in France or private like the network of 20 centres for children set up by the Arturo Rosenblueth Foundation for the Promotion of Science in Mexico in the framework of the "Galileo: education for the 21st century" project.

- Lastly, some countries organise public demonstrations on a varying scale: the "Young People's Computer Olympics" in Argentina and the "Information Technologies Month" organised every year by the Federal Ministry of Science and Technology jointly with the National Computer Society in Australia.

Management applications

Computers are to be found in all education ministries to varying degrees. Some countries have developed completely computerised management systems like Brazil and France and some have instituted national programmes like the Schools Computer Administration and Management Project in the United Kingdom and the Educational Computing Network of Ontario. Lastly, some are in the first stages of computerisation like Argentina, El Salvador, Paraguay and Kenya.

It is for administrative management that the use of computers is most widespread. Practically all countries have computerised their staff pay and contract administration. Budgeting and accounting are also computerised in many cases as, to a lesser degree, are statistics, staff management, and the administration of fixed and movable assets. Conversely, the use of computers seems fairly rare in complex operations such as analysing the cost or efficiency of the educational system.

Under educational management relatively few uses are found although some countries like Japan, Canada and France have particularly developed this sector. Applications in this field mainly concern the administration of examinations and tests, to a lesser extent pupils' records and in very few cases school career guidance, evaluation, documentation and educational research.

Whilst the most frequently computerised functions are those of administrative management this may be assumed to be due to the availability of standard software and staff capable of running it since programs for this purpose are the least specific to the educational world.

Administrative decentralisation in many countries requires that information processing be regionalised. Apart from the purely physical problems (the amount of hardware required, incompatibility, maintenance problems, etc.), decentralisation seems to create conceptual and logistic problems in organising the information flows (data harmonization, adaptation of national applications to suit the specific local conditions, etc.) which seem to have been solved in very few countries.

Lastly, many countries regret the lack of qualified staff and the low level of resources allocated to the computerisation of management systems.

Software

A complaint that keeps coming up from various countries concerns the lack, unsuitability or bad quality of available software. Even in national plans, software comes second in the authorities' concerns, witness the scale of investment considered in the first part of this summary. Some government schemes even fail to mention it and there is no provision for any special measures in this field.

Unlike other educational materials, software circulates internationally from its country of origin (generally one of the English-speaking countries). The use of imported products then creates two types of problem: educational problems (unsuitability for curricula) and cultural problems (linguistic problems for countriesa where English is not spoken and then in terms of the "models" they bring with them, often far removed from the social and cultural reality of the importing countries).

Most countries, therefore, have embarked on their own production on varying scales. This applies to 75% of the countries in the sample under review. But for over 20% of them this is "cottage industry" production falling far short of real educational requirements. Even a country like Australia exporting simulation courseware still depends for the most part on imported software because domestic production is not enough.

With the exception of Chile and the United States, software is everywhere produced within the educational system by teachers and, more rarely, by universities, sometimes (20% of cases) in association with private industry.

Only five countries have national production plans. In Ontario the Ministry of Education invested 5.4 million Canadian dollars in 1984 in software production alongside the scheme for the production of the ICON specialised microcomputer. This amount is to be increased to 10 million dollars in 1986. In Spain, the ATENEA project launched in 1985 calls for an investment of 524 million pesetas over 5 years representing the Ministry of Education's participation in a production programme to which the Ministry of Industry,

hardware manufacturers and school publishers are also contributing in the framework of an Association for the Development of Educational Software. For its part, Hungary has invested 8 million Forints in two years launching its national informatics scheme and has organised two successive competitions for the production of educational software by teachers and students. In addition, various institutions have set up a joint production structure called TEACHSOFT. In this way, 250 locally produced programs, evaluated and validated, have been supplied to schools over a period of 2 years. After first excluding private publishers from the educational market (by imposing a special author language), France is now gradually involving them in production, alongside the hardware manufacturers, under the terms of the Informatics for All programme. It has also financed the development of a new author language enabling teachers with no knowledge of programming to design software, most of the production being carried out in the school milieu or delegated to the National Centre for Educational Documentation (ovr 500 programs produced). Lastly, a similar trend has been noted in the United Kingdom where production is now partly in the hands of the private publishers whereas previously, under the MEP and SMDP schemes, it was the responsibility of the school authorities.

For most countries, the problems of software portability have not been solved. Some countries have settled them partly by standardising measures applying to hardware: schools being required to choose certain kinds of computer or one and the same operating system for hardware used in schools. Others, like Hungary, Denmark (with Comal 80), Ireland and to a lesser extent the Netherlands, guarantee de facto the portability of software and their possible exchange - at least among schools - by adopting standard programming languages (often Basic or its derivatives).

The largely domestic production of software is not, for all that, a guarantee of quality and very many countries complain that they are often of a low standard.

Little information is available about how software quality is checked but, with the inventory as it stands at present, only 8 countries report preventive measures designed to guarantee the educational value of software before it is distributed to classes. For countries having a national informatics policy, quality control is generally the responsibility of central agencies responsible for software production or centralisation. That is where it is evaluated and validated. This applies in Spain, Hungary, France and the United Kingdom. In Finland, the function is performed by the National Education Council, schools being encouraged to give preference to "approved" programs - approved in the sense that public assistance to schools is conditional on their purchase. In Canada, the colleges organise selection and assessment committees or publish magazines, like "Microware" in British Columbia, which critically review new software. In some FRG Länder, public institutes responsible for software distibution also perform quality control and give advice to schools whereas in Austria, only programs for vocational education are assessed by specialised teachers appointed by the Ministy of Education. Lastly, in the United States the problem is even more critical in that there are 750 producers and 20,000 programs on the market. Only 10% is estimated to have been assessed. Various services for quality control and the publication of critical data on software quality have sprung up including Microsift (Northwest Regional Educational Laboratory), Educational Products Information Exchange, Conduit Consortium in Iowa and the CUE (Computer Using Educators) association in California.

Few measures seem to have been taken at central level by the education authorities with regard to software distribution. Except for those countries which have concerted plans for the introduction of informatics in educational systems, where software is distributed by agencies which also control production and quality (though not exclusively because part of production is also distributed on a commercial basis), distribution methods are many and varied: marketed by publishers or hardware producers in Sweden, Australia and the United States, by teachers' associations in Japan, groups of users and computer training associations in New Zealand and public institutes and private associations in FRG. The last point is that new and as yet experimental distibution techniques are beginning to appear such as the downloading of software over data network links in Australia (Austpak network), Ontario (Educational computing Network of Ontario in conjunction with the Ontario Educational Software Service) and in the United Kingom (School Link over the Prestel network).

Teachers

On top of the economic problems holding up school equipment and the shortage of software there are problems in the way of teacher training. Whether it be in the field of initial training or that of continuous training, few countries seem to have taken the necessary steps to prepare the teaching body for the use of computers. Authorities, up to recently, seem to have accorded this problem little attention and few resources. Several countries however (India, Chile, Korea, Cuba and Mexico) have recently launched a national teacher training programme or plan to do so in the near future.

But it is clear that the difficulties of providing training on a mass basis are very great. Even in those countries that have made a major effort in this field the percentage of teachers trained is still low: 20% in Sweden and the United Kingdom, 25% in France and 4-30% in Australia depending on the state. Canada has a fairly clear lead with 37% of its teaching body trained.

In most other countries, in spite of the roughness of the estimates received, it would be reasonable to assume that the figure is generally below 5% (2% in Latin America for example).

For countries with systematic schemes for including informatics in education, training methods are often similar. Arrangements for initial training are generally made in the establishments usually responsible for teacher training. The accent is on up-dating practising teachers and the objectives are short and medium-range. The short-term objective is to quickly meet the requirements of teachers capable of using computers in the classroom and for this short 6 to 15-day courses are organised. For the medium term it is a question of training instructors who then pass on what they know to user teachers, in other words they give crash courses which in theory enable the critical mass to be reached that is necessary for the complete conversion of the educational system.

In all countries, training measures are unsystematised. In-service training seems to be developed to a greater extent than initial training. It is generally optional except in some countries like Norway and Finland which have computer science in technical and vocational curricula, and in some North American states. In most cases responsibility for training lies with the education authorities (teacher training schools or higher education

establishments and the local school authorities) but also in some cases with teachers' associations and computer manufacturers. Distance education programmes are sometimes offered: in Great Britain by the Open University, BBC and National Extension College and in Ontario by TV Ontario in the form of a multimedia package designed for primary and secondary teachers and called Microcomputers and Learning.

A last point is that several countries report self-teaching initiatives by teachers. This applies in Norway, the Netherlands, Austria and Chile.

Research

The range of research activities is fairly wide. By decreasing order of frequency of mention in the monographs there are:

- Research centred on Logo: application of Logo to mathematics teaching in Mexico (National Polytechnic Institute), use of Logo in rural areas (in conjunction with the literacy programme) in Colombia and Brazil and cognitive research in Argentina and France (part of the "Active computer practice by the child" programme). The pilot Logo experiment conducted in Dakar by the "Informatics-Education" Laboratory of the Educational Research Centre of the Higher Teacher Training School in Dakar is also the framework of research on the teaching of subjects and the development of a Logo-wolof language.

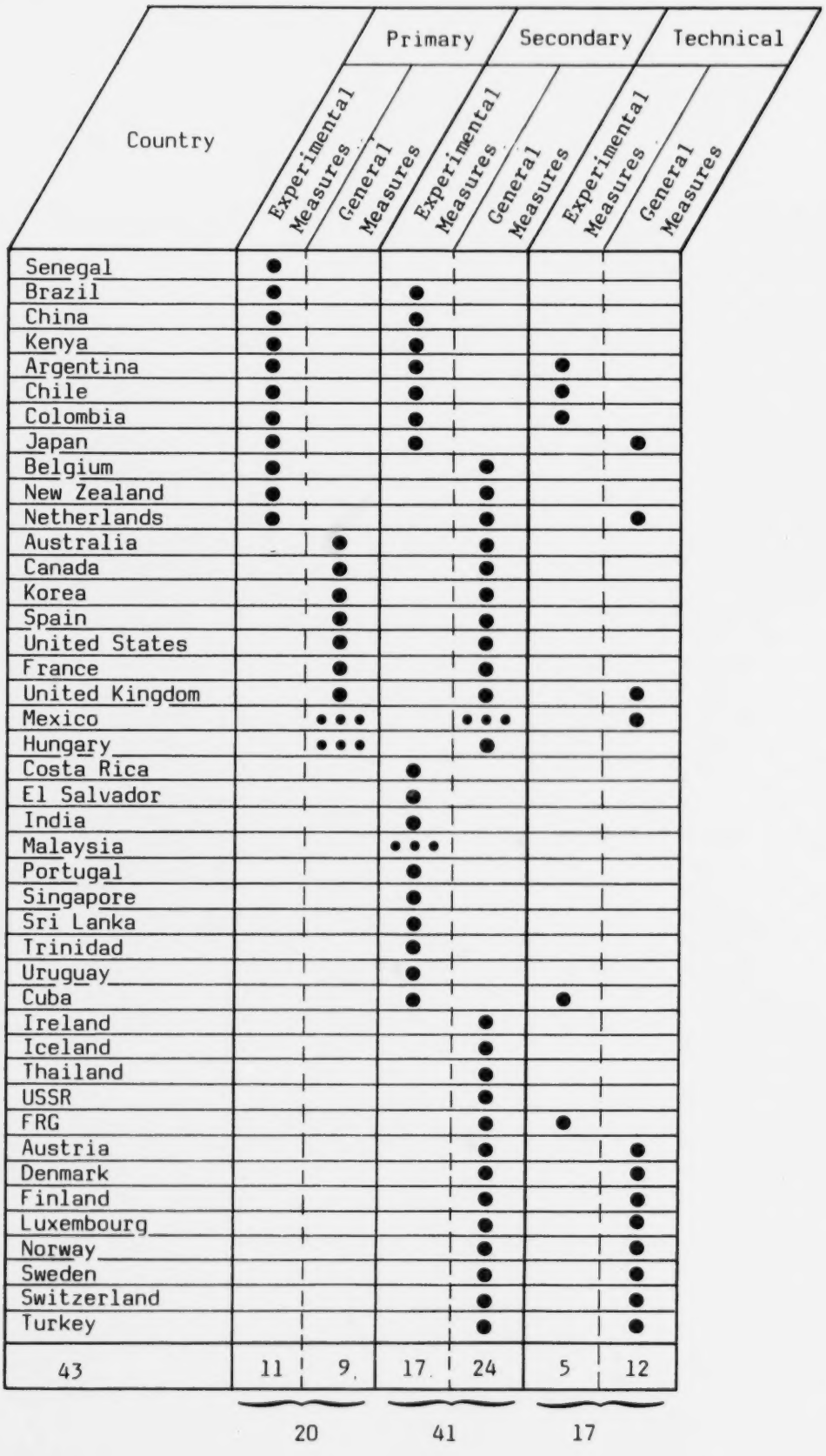
- Research on computers in special education: Logo experiments with multiple-handicapped pupils in Trinidad and Japan (Ibaragi University), reading and writing lessons for deaf children and those with minor intellectual handicaps in Australia (Australian National University), computer uses for training children with hearing defects in Mexico, informatics and special education in Argentina and the SEMERC (Special Education Microelectronics Resource Centres) programme in the United Kingdom on the adaptation of machines to children's needs and capacities (touch-type screens) and the production of special software in conjunction with the medical world.

- General educational research: evaluation of the educational applications of computers in Santiago University, the definition of course contents to meet the requirements of the industrial and tertiary sectors and the study of learning processes in the framework of the National Learning Service in Colombia, the social impact of informatics in Argentina and the adaptation of aids and programs to regional social and cultural realities (Amazonia) in Brazil.

- Research on subject teaching: research on CAI (computer aids for learning programming, teaching English and test databanks) in Colombia, design of computer-based systems for teaching mathematics at the University of Santiago and the QUILL research programme on the use of microcomputers in teaching writing in the United States.

- Research on languages: development of the PIPO language (a Pascal derivative) at the Free University of Amsterdam and of a specific ELAN language for secondary education at the Catholic University of Nijmegen (Netherlands), the development of a Spanish version of micro-prolog in Chile and that of graphics software in India.

- Research on the computer processing of national languages (India and Japan) and the tropicalisation of hardware (India).


Country
Primary
Secondary
Technical
Experimental Measures
General Measures
Experimental Measures
General Measures
Experimental Measures
General Measures
Senegal
Brazil
China
Kenya
Argentina
Chile
Colombia
Japan
Belgium
New Zealand
Netherlands
Australia
Canada
Korea
Spain
United States
France
United Kingdom
Mexico
Hungary
Costa Rica
El Salvador
India
Malaysia
Portugal
Singapore
Sri Lanka
Trinidad
Uruguay
Cuba
Ireland
Iceland
Thailand
USSR
FRG
Austria
Denmark
Finland
Luxembourg
Norway
Sweden
Switzerland
Turkey
43
11
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17
24
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12
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17

A L G E R I A

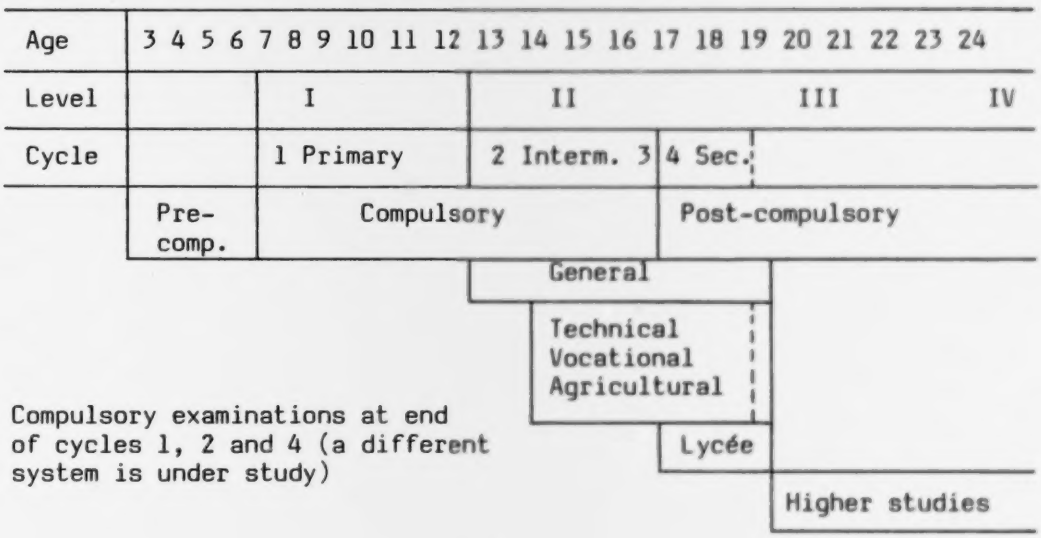
Basic data

Total school population: 4 474 660 (1981)

Education budget:

as percentage of GNP:

Structure of educational system:



Compulsory examinations at end of cycles 1, 2 and 4 (a different system is under study)

	School population per level	Number of teachers per level
Primary	3 241 924 (1982)	100 288 (1982)
Secondary	1 154 709 (1981)	47 771 (1981)
Tertiary	78 027 (1981)	9 778 (1981)

Informatics policy

The Algerian government has framed a five-year Plan (1985-1990) for the development of computer science teaching with three objectives: the training of specialists, the general introduction of informatics teaching in all the other disciplines and the training of instructors. The Plan defines the type of establishment that should produce proposals as to training, hardware requirements and arrangements for equipping schools.

Research

Arabisation

- Research on control of the functional linguistic balance at primary level conducted by the Arab Organisation for Education, Culture and Science.

- Arabic dictionary. Being carried out by the Linguistics and Phonetics Institute of Algiers University. The project consists in creating a computerised database of Arabic vocabulary from the "Al Jahiliyya" period till today.

- Creation of a terminological database (scientific vocabulary).

- Research on the machine translation of Western scientific books.

- Research on computer assisted teaching of Arabic, being carried out by the Linguistics and Phonetics Institute of Algiers University.

- Work on (Arabic) voice synthesis and recognition.

Educational research

- Study of optimum conditions for the definition of strategies for computerising the educational system.

- Study of the content of computer science curricula and of the ways in which informatics might be used in teaching other subjects.

Source: Introduction of informatics in the educational system of the Arab world. Regional Office for Education in Arab countries. Unesco Nov. 1985.

ARGENTINA

Basic data

Total school population: 6 115 000 approx.

Education budget: 35 773 million new Pesos
as percentage of GNP: 2.5%

Structure of education system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I II III IV
Cycle	1 2 3 4 5 6 7
	Pre-compul. Compulsory Post-compulsory
	Intermediate Academic Technical Commercial
	Teacher training University
	Further education

Compulsory examinations at end of cycle 4-7

Argentina being a federal state, direct control over education at the pre-school and primary levels (basic education) is in the hands of the provinces. The universities are independent. The only data available at national level are those for intermediate and higher (non-university) education which comes under the Federal Ministry of Education.

	School population per level	Number of teachers per level
Primary	4 197 372 (1982)	206 535 (1982)
Secondary	1 366 444 (1981)	178 681 (1980)
Tertiary	550 556 (1982)	53 166 (1982)

COMPUTER POLICIES

Industrial background

The Argentinian electronics industry developed strongly from the mid-60s to the second half of the 70s, its expansion being related to the protectionist policy of the period which favoured the development of a market for local producers.

Up to 1976, Argentinian industry met 69 per cent of domestic demand, but then the de-industrialisation process began in this sector as a result of the reduction of customs tariff protection, the overvaluation of the local currency, rising interest rates and the fall in the purchasing power of the state, the bigest buyer of electronic goods and computer user. The completely open policy to imports introduced in 1976 led to the death of the country's electronics industry: in 1982 domestic sources supplied only 20 per cent of the domestic market and the local industry reverted to the embryonic form it had at the beginning. A large number of manufacturing firms disappeared, including the biggest, Fate Electronique, in 1978 and others became mere sales agents.

There are currently three firms producing computer hardware, two transnational and one national in Cordoba. Their total capacity is one hundred units including 8-bit microcomputers. Three other "cottage industry" companies make 8 and 16-bit microcomputers (about 5 a month each).

In 1983 the number of computers in use in the country totalled 23 000, 80 per cent of them personal and business micro and mini-computers.

As regards software, 200 firms are estimated to be active developers. They have formed an association called the Chamber of Software Companies.

Government policy

To rectify this very bad situation, the Argentinian constitutional government, as soon as it came to power, made the definition of a national computer policy a matter of urgency. In circumstances in which the country needed to embark upon a process of re-industrialisation and surmount its problems of external indebtedness, computers represented an instrument for developing production. The computerisation process had to be used to stimulate the growth of a national computer industry and to help reduce the country's dependence in this sector.

In 1984 the government set up an interministerial National Informatics Commission with the task of defining a national computer policy. In its report the Commission, taking the view that the basic object to be aimed at was national technological independence (this being inseparable from the mastery of concrete technological know-how), proposed the following: the introduction of incentives for industrial promotion, public financing of R&D in high-risk, high-cost sectors, the reform of tariff policy, the control of foreign investment and the training of skilled manpower of the necessary quality and quantity to ensure the development that was planned.

The implementation of this policy was entrusted to the Informatics and Development Under-Secretariat set up in 1984 in the State Secretariat for Science and Technology.

Aspects concerning the use of computers in the field of education were addressed in the report presented by the National Informatics Commission in 1984 (see above).

The Federal Ministry of Education and Justice, for its part, set up a National Computer Education Centre (CENEI) in 1984 which launched a national survey, in collaboration with the Informatics and Development Under-Secretariat on computer applications at all levels of the education system(1).

BASIC EDUCATION

No precise figures are available but it is known that computers are used as a teaching aid in certain private basic and intermediate education establishments.

Official basic curricula include initiation in computer concepts and computer literacy: description of hardware, principles of use, basics of programming and problem-solving applications.

SECONDARY EDUCATION

Pilot project

The National Informatics Education Centre (CENEI) has launched a pilot experiment on computer applications in secondary schools under the name "La Computadora como Herramienta de Trabajo". The experiment began in 1981 with the collaboration of 92 schools across the country and 18 000 schoolchildren working in school computer rooms. The schools taking part come under the following authorities:

- The National Directorate for Intermediate and Higher Education.
- The National Technical Education Board.
- The National Private Education Supervisory Authority.
- The National Artistic Education Board.

The purposes of the experiment in these schools are as follows.

- To teach children how to distinguish between the problems that can be solved by computer and those that cannot;
- To teach programming in Basic;
- To teach pupils how to apply the knowledge of algorithms to the solving of problems;
- To open the door to research and to creative activities in the computer field in general.

Each school is provided with at least 5 microcomputers and one printer.

The first steps in programming are taught in the 3rd year of the first cycle (age 14/15) in mathematics and accountancy lessons. The children follow a rota, working two at a time at the terminal, and have one hour's instruction per week. As of the fourth year, the children use the computer to solve specific problems in two disciplines.

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(1) The results were not available at the time of going to press.

This experiment is accompanied by special training measures for supervisory staff, under direct CENEI responsibility:

- Familiarisation course for inspectors and officials of the supervisory authorities responsible for the schools taking part. The course lasts 35 hours and is given at CENEI.
- Similar course for heads of establishments who are specifically informed of the practical arrangements of the experiment.
- Training of the teachers in the disciplines where the use of the computer is to be taught. This training is given in two stages:
  - First level course (1 month or 140 hours) in regional training centres
  - Second level (1 year) in-service training with the aid of co-ordinators. 1000 teachers were trained in this way in 1984.
    Co-ordinators are teachers who have successfully followed both these courses plus a third of 4 weeks or 140 hours at CENEI to qualify as teacher trainers in school establishments: two teachers are appointed per school.

The experiment is being monitored and assessed by CENEI which has also developed research activities around the experiment in the fields of computer teaching, computer-aided education and the influence of the computer on the development of formal thought.

SUMMARISED HISTORY OF THE PROJECT

	1981	1982	1983	1984
Schools installed by the state	22	30	53	92
Qualified teachers	60	150	400	1 000
Pupils	1200	3000	10 000	18 000
Hardware installed by the state	85	85	130	?
Total hardware installed	100	150	260	450
TRAINING COURSES				
				Planned
First level	8	18	17	20
Second level	-	-	21	35
Co-ordinators	-	1	1	1
Heads of establishments	1	1	1	2
Inspectors	2	1	1	4

Source: Simposio internacional - San Miguel de Tucuman, Argentina, 30 April/4 May 1984.

Extra-mural activities

Outside the strict framework of school activities, students are invited to take part in research activities on subjects of their own choice. In 1985 this kind of initiative was the origin of the First Young People's Computer Olympics" in which 150 Argentinian and Paraguayan children competed.

This was followed by the formation of in and out-of-school microcomputer clubs up and down the country which, apart from anything else, enable children not in the project schools to take courses at the clubs and teachers in the same situation to take the first and second level courses.

TECHNICAL EDUCATION

Since 1981, a computer training experiment has been under way run jointly by the State Plan Secretariat and the IBI??? Originally it consisted in teaching Basic to third year pupils in technical vocational training schools but later it was extended to the 4th and 5th years.

The project is currently being assessed and the results of that assessment should enable the aims of the experiment, which it is intended to continue, to be re-adjusted.

HIGHER EDUCATION

Example of a pilot application : Computer aided instruction at the Chemical Engineering faculty of the National Seaboard Ubiversity (UNL) at Santa Fe

This Chemical Engineering faculty has set up an Applied Educational Technology Centre (CETEA) to design and develop educational aids for teaching and research.

This centre is the hub of the computer-aided instruction (CAI) experiment initiated to develop courseware modules for the basic sciences (physics, chemistry and physical chemistry) and the technological disciplines in the chemical engineering curriculum (electrochemistry, electrical engineering, etc.).

Some technical modules are designed so that they can be used in secondary technical schools. The software is designed by groups of teachers ("development groups") under a CAI management team in conjunction with CETEA.

The project was formulated in November 1983 and put into effect in March 1984.

In the first year ten "development groups" were formed, totalling 26 teachers, working 4-6 hours a week on the production of 11 modules in the disciplines referred to.

RESEARCH

The research laboratories are working on such topics as the computer as a teaching aid in the teaching of disciplines, the effect of the computer on the development of intelligence and its social and psychological impact, and the computer and special education.

Various pilot projects focussing on these different aspects are scheduled for in 1985.

Software

Teams have been set up by the Ministry of Education and Justice to develop software to meet Argentinian requirements and problems and more generally those of the Latin-American region.

Teachers

There does not seem to be any overall policy for the training of teachers in informatics. As has been indicated specific training arrangements have been defined in pilot projects but there are no other provisions for training and teachers gain familiarity with the subject more through educational seminars and conferences.

MANAGEMENT APPLICATIONS

At the central level, i.e. that of the Ministry of Education and Justice, the computer is used to administer the pay of teaching and administrative staff and also, though to a lesser extent, for statistics management. Since early 1985 the Ministry has had a work programme in operation consisting of quarterly modules within which applications are developped in relation to staff management, accounts, the budget and statistics.

By 1988, it is hoped that an all-embracing computerised administration system will have been set in place.

As a second phase it is planned to extend the system to the management of pupils' files, the management of human and material resources, the constitution of databanks and examinations. Computer facilities will also be used, but to a lesser extent, to make inventories, run national examinations, operate the school career guidance system and draw up curricula.

As a way of promoting the growing use of computers, the Ministry of Education and Justice has opened a specialised library and documentation centre.

Because of the decentralised nature of the educational system, the Federal Ministry has no central management system, so the collection and formatting of data concerning management, planning and organisation are subject to various procedures involving both central and local levels. In some cases data will be collected and processed at the regional level and then aggregated at national level; in others - including in particular the administrative management system - the intention is to devise a centralised system at national level.

The plan is to make the the Under-Secretariat for Informatics and Development or the Civil Service Secretariat (which reports directly to the President's office) responsible for defining norms and standards.

To back up its management computerisation policy, the Ministry of Education and Justice is organising training sessions for its administrative staff.

It has also developed the beginnings of a computer network with three provinces and set up a working group to design an information system on the Ministry's manpower resources.

OTHER DEVELOPMENTS

Argentina is visibly concerned to see regional cooperation in informatics grow along the following lines:

- Exchanges of staff, fellowships and seminars;
- Creation of a regional information network;
- Exchanges of teacher training experience and programmes;
- Working together on software design;
- Joint evaluation machinery.

Sources:
- Desarrollo de la informática en los sistemas de educacion de paises de America Latina y el Caribe. OREALC/Estadisticas/36. Vol.I, March, 1985.
- Informatica y educacion. Simposio internacional, 30 April/4 May 1984. San Miguel de Tucuman, Argentina, 1985.
- Extracts from the basic document on informatics and electronics in Argentina produced by the National Commission on Informatics. Quoted in AGORA 1985/2.
- First outline of an informatics policy by Carlos Maria Correa, in AGORA 1985/2.

A U S T R A L I A

Basic data

Total school population: About 3 137 000 (1982)

Education budget: 8 580 000 000 Aust. dollars (1981)
as percentage of GNP: 5.8% (1981)

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26				
Level		I	II	III	IV
Cycle		1	2	3	4	5	
	Pre-comp.	Compulsory		Post-compulsory	
				High. sec.	
				Primary teacher train.	
				Secondary teacher training	
				University	
					Post-graduate

Compulsory examinations at end of cycles 2 and 5

	School population per level	Number of teachers per level
Primary	1 660 000 (1982)	91 386 (1981)
Secondary	1 139 820 (")	86 364 (")
Tertiary	338 000 (")	19 377 (1982)

Computers in use in education: Over 10 000 units.

History of the introduction of computing into the educational system

Computers have been used in Australian schoools for educational and administrative management purposes for over ten years. In the universities they have been used as research tools for even longer. The first measures regarding the use of computers in education were taken for second cycle secondary schools. These were followed by similar measures for first cycle secondary schools and then for primary schools. The situation differs in different states but they all follow the same general pattern.

The involvement of the Commonwealth Schools Commission in computing is seen as a major development. In early 1983, the Commission recommended that $A125 million should be allocated for computer education over the next five years. In July 1984, the Government decided for a more modest initial investment: $A18 million only for the triennium 1984-1986. Initially the programme will concentrate on secondary schools. For the period beyond 1984 the Commission is asked to prepare options on possible directions for the programme, including extensions to primary schools.

In 1983-1984 the pace at which microcomputers were being introduced into schools quickened following the publication in 1983 by the Schools Commission of a report containing recommendations regarding the institution of a national programme for the computerisation of education over the period 1984-1986.

The publication of this report was followed in 1984 by that of a second document "Computing in Schools" (Anderson) by the Australian Pedagogical Research Council.

These initiatives enabled co-ordination of action throughout the territory to be strengthened with particular regard to curricula for the training of teaching and administrative staff, hardware and the general organisation of the programme, specific recommendations having been made in this field by the Schools Commission.

The main problem identified by the 1983 report was the need to train teachers in this specific sector.

Another was the problem of equality of access to computer instruction for the various school populations (boys/girls and allowance for geographical and socio-economic disparities).

Present situation

Obstacles to the introduction of a computer-based teaching programme in schools consist primarily of the lack of qualified teachers at all levels and the absence of suitable courseware.

Most CAI programmes marketed in the country do not correspond with current teaching practice and their non-selective use slows up the rate at which the class can learn.

Another major obstacle is the supply of technical and maintenance services in remote parts of the country.

Further information

The Australian educational system is decentralised and each state defines its own educational policy. Problems bound up with the introduction of computers into public education are handled differently by the eight government authorities concerned.

Private education is independent and formulates its own policy in this field.

The main defenders of the computers in education case are groups of users which have formed in all the states and organised conferences for teachers and teachers of teachers.

The Australian Computer Society is also concerned to see the growth of computing in education just as are most professional associations which are paying increasing attention to educational technologies and in particular the use of microcomputers.

As has been said, the federal government defined a national programme for the computerisation of education for the first time in 1984. The objectives of the programme are:

- To enable schoolchildren to learn about computer technology and to think about the social impact of computers.

- To integrate the computer in all school programmes.

The implementation of the national programme is the responsibility of the National Advisory Committee for Computers in Schools. In particular it is responsible for the study of the specific requirements of primary education, the assessment of the national programme, the development of software and the definition of technical standards for educational micro-hardware.

Public and private systems in all states are supervised by co-ordination committees.

PRIMARY EDUCATION

Hardware

It is estimated that 15% of primary schools have at least one microcomputer. In two states (including Tasmania) over 85% of schools have them.

Hardware funding is provided mainly by the schools and local communities.

Some states offer financial assistance to schools that purchase "approved" hardware. In Western Australia for example (which has formulated a plan of action for the use of computers in primary schools), the government bears 50% of the purchase price of a computer system.

Types of application

There is a trend towards the gradual abandonment of CAI in the form of repetitive exercises in favour of word processing programs (for learning to write), the use of data bases (programs such as "The first fleet", "Birds of Antarctica" and "Somerleyton census" produced by the Elizabeth Computer Centre)(1), introduction to Logo, simulation ("Tasman Castle", for example, exported to the United Kingdom and the United States) and other non-directive applications.

In the field of simulation, the Schools Computing Centre of Western Australia is developing pilot projects for the production of simulation courseware like the "Dirigibles" program (science courseware) and the "Number Base Conversion" program for the teaching of mathematics.

In all states, an introduction to computers is given in primary schools but none actually teach computing at this level.

Teachers

Short courses (generally optional although some states have made them compulsory) are offered by teacher training institutions.

Currently, however, the trend is more for the development of further training activities in two forms:

- Short (20-hour) and long (6-week) courses provided by the Education Department and teacher training associations.

- Computer teaching diplomas given by many "colleges of advanced education".

The proportion of teachers (at all levels of education) that have had some in-service computer training is estimated at between 5 and 30%.

SECONDARY EDUCATION

Hardware

Most secondary schools have at least one microcomputer. In Tasmania all schools have microcomputers.

Funding is provided mainly by the schools and local communities. As for primary education, some states offer help to schools purchasing "approved" equipment. For example, Western Australia provides up to 50% of the purchase price of a computer system.

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(1) A pilot project for an educational data network is currently being developed under the name "TASNET". Its purpose is to give the schools of one state access to foreign data bases and news services generally reserved to the press. The intention is that the network should allow pupils to make their own selection of news and to compare it with the choice made by the editors of local newspapers.

Types of application

Schools in all states give Computer Literacy Courses based on real situations and relating mainly to the social aspects of computerisation.

As for the teaching of computer science, the situation varies considerably from state to state. In Victoria and Tasmania computing is available as a university entrance subject. Other states offer courses at senior secondary level but some offer no formal courses in computer science, e.g. South Australia.

A general point is the gradual abandonment of the teaching of programming in Basic. Introductory programs to the Pascal language (e.g. "Karel the robot") are used in some schools.

Software

Production

Most states rely on commercial software producers for the bulk of their software needs. Some states have centres which develop software for schools but this can only account for a small fraction of the total software needed.

Diffusion

All states have set up some type of structure for the distribution of software. AUSTPAK, the public packet switching network, is expected to play an important role in improving the long-distance transfer of courseware. Also, the first Australian satellite is to be launched in 1985 and this is also expected to assist with data communication by linking together some or all of the states enabling them to exchange their educational software.

Already three states, Tasmania, South Australia and Western Australia, have decided to share their software resources.

Teachers

The situation as regards teacher training varies from one state to another but all secondary teacher training institutions now offer some type of computing unit in their courses.

Most computer training, however, is organised on an in-service basis.

INFORMAL EDUCATION

Once a year, an Information Technologies Week is organised, sponsored by the federal department responsible for science and technolocy and the Australian Computer Society.

Various cultural activities are held during the week, the object being to increase the community's awareness of the computer phenomena.

The success of this event over the years has prompted the authorities to convert it into an Informational Technologies Month from 1984 on.

SPECIAL EDUCATION

Research

The most significant research on the computer in education is the project which has been conducted for over ten years at the Australian National University and concerns special education. It is being carried out by the Information Sciences Laboratory and its first aim is to help children with slight intellectual handicaps to learn to write. More recently it has been concerned with learning to read.

The present objectives of the research team are to use the results of laboratory experiments to develop applications that can be used in class (the microcomputer as an aid to learning to write, read and count).

FUTURE PROSPECTS

In formal education there is an urgent need for the development of the right kind of educational software and materials and vocational training programmes.

With regard to teacher training, which concerns a considerable number of teaching staff, ways of solving the problem are being sought in the use of mass communication media and self-teaching (multi-media modules) and also in in-service training at the workplace and in working time by person-resource teachers.

Sources:- Final Report of the Third Asian Seminar on Educational Technology, Tokyo, 26 Sept./2 Oct. 1984, APEID 1984.
- Document CERI/NT/84.02 (OECD).
- Commonwealth Schools Commission, Teaching, Learning and Computers, 1984 Information kit, Canberra, 1984.

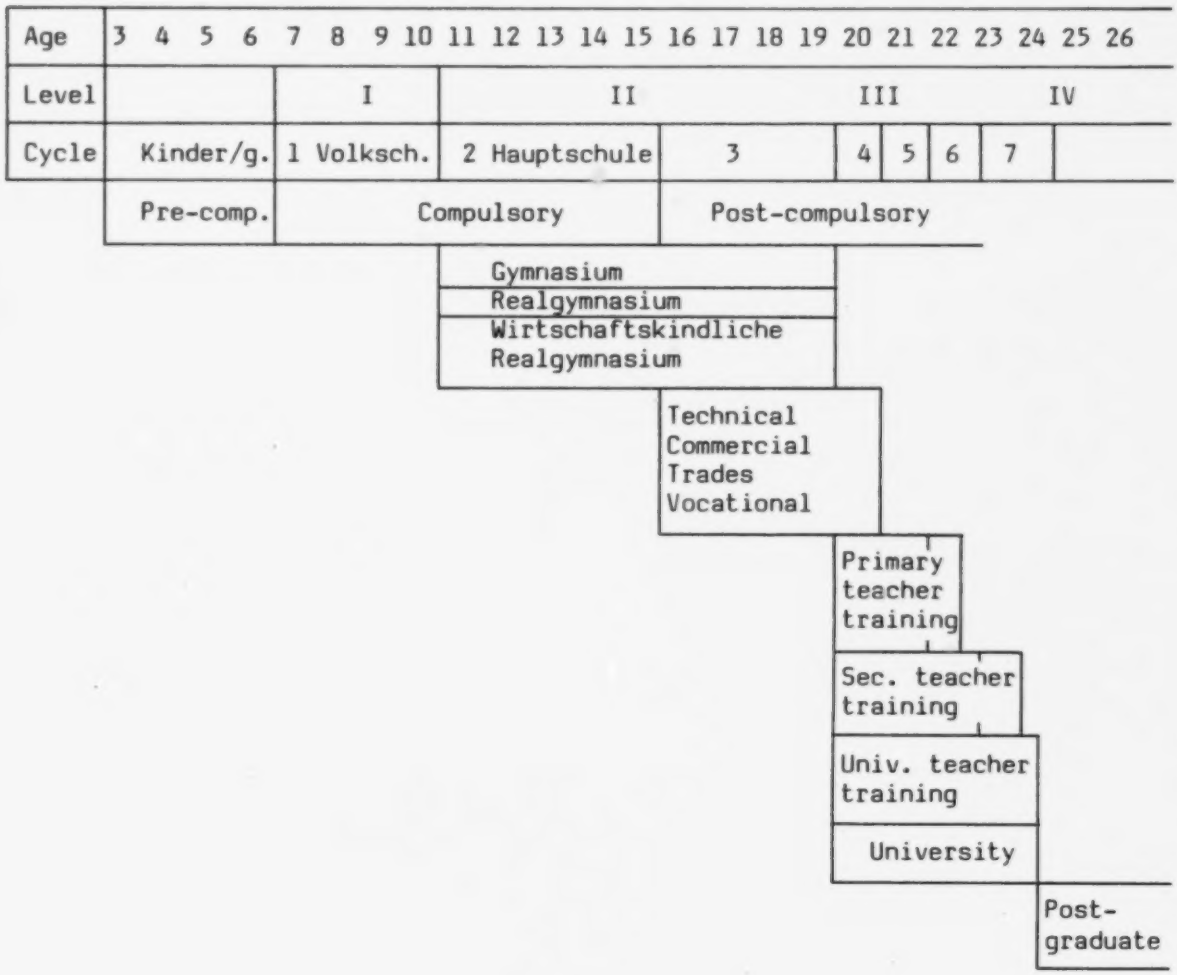
AUSTRIA

Basic data

Total school population: About 1 135 000

Education budget: 61 157 100 000 Schillings (1982)
as percentage of GNP: 5.9%

Structure of educational system:



	School population per level	Number of teachers per level
Primary (in 82)	367 691	27 731
Secondary	705 441	66 756
Tertiary	59 778	6 980

Background

The educational system is highly centralised. Major curricular changes require a two-thirds majority in parliament. Changes in the content of a subject can be decreed by the Minister of Education after submitting the draft for comment to the nine provincial school boards (this is required by law) and to a considerable number of groups representing different interests (unwritten law). Pilot projects are possible at any time but their number is strictly limited.

New curricula may be formulated with the help of teaching staff at all levels as well as representatives of employer and employee associations. The two basic issues as regards innovations - relevance and feasibility - are decided on the basis of experience and common sense rather than research. The universities are asked for their views only in the case of subjects required for university entrance. Pupils are not involved except through informal feedback.

Current situation

Austria's kind of educational system is not conducive to penetration by initiatives at grassroots level or of a piecemeal nature - generally typical of the first phase of the penetration of the new information technologies in education systems. The primary level is virtually untouched; partial introduction in the general secondary level is planned for 1985.

The only educational level fully penetrated by the new information technologies is the one directly linked to the labour market's needs, namely the vocational schools, which are attended by 68 per cent of all full-time pupils (37 per cent with university access and 31 per cent without).

PRIMARY EDUCATION

Training of primary teachers is in the concrete planning stage.

SECONDARY EDUCATION

By 1985, all secondary schools (years 5-12 or 9-12) are expected to be equipped - planned annual expenditure: 20 million Schillings. By school year 1984/5, Electronic Data Processing will be an option for the general secondary school leaving examination.

A Ministry working group has made a start on preparations for the general introduction of Electronic Data Processing as a subject in upper secondary schools. Two hours per week will probably be compulsory for the first two years and optional thereafter. Students will therefore have some control over the extent of their training in the subject.

As a result of the Ministry's planning strategies over the last few years, all general secondary schools have an average of 2-3 teaching staff trained in the subject.

UPPER SECONDARY EDUCATION

Hardware

In three of the nine provinces, approx. 35-40 per cent of schools have been equipped with a configuration of four terminals each consisting of a 64 K-byte (minimum) microcomputer, twin disc drive, screen and printer.

Finance is provided by the federal authorities but the private schools meet their own costs. Over 20 million Schillings has been spent over a period of two years.

Types of application

Instruction on computer applications and their social consequences is given in several subjects.

Electronic Data Processing, possibly included in advanced mathematics, is an option in mathematics teacher training.

Software

Software is generally of commercial origin but some is developed by teachers and/or students. Portability of software is ensured by standardisation in hardware (particularly with the use of the CP/M operating system) and manuals.

Teacher training

Initial data processing training is an option for would-be mathematics teachers. There are many further training courses open to all teachers but they are mostly attended by those teaching mathematics. A large proportion of teacher trainers are self-taught in micro-electronics.

VOCATIONAL EDUCATION

Informatics courses are being introduced in hotel and agricultural and also, gradually, industrial training schools.

Austria's apprenticeship education and training covers 225 trades. Apprentices spend 20 per cent of their time in part-time vocational schools. These are financed by the provincial authorities whose responsibilities therefore include the purchase of hardware, implementation of the national curricula and determining the extent to which microcomputers are to be used in vocational schools. As of 1984 electronic data processing has been an official part of training in commercial and related trades using curricula based on experimental projects run during the last few years.

Hardware

Commercial schools

Each of the over 100 commercial schools with university access has one single-function classroom (two in the larger schools) with ten terminals consisting of a 64 K-byte microcomputer, screen and twin disc drive. Groups of five terminals are connected to a printer via a selector

switchbox. There are never more than eighteen students in a class (larger classes are split) making a maximum of two per terminal.

A total of 1 300 microcomputers and 260 printers are now in use in the commercial schools; the computer rooms are equipped to a standard specification. Some schools have minicomputers, used for computing proper, and special software is available to enable the microcomputers to be used for accountancy and word processing.

Industrial schools

There are over 40 industrial schools with university access using mainly multiple access systems with six to ten terminals, average capacity 256-512 K-bytes. One industrial school in Vienna trains computer specialists for the business and industrial sectors.

Financing

Hardware is financed by the Federal authorities except for the private schools which are self-financing. Over 150 million Schillings have been spent in a period of three years.

Software

Production

Software for commercial schools is developed by computer firms, teachers and school administrators. For the industrial schools courseware is supplied by commercial firms but is sometimes developed by teaching staff.

Quality control

This is entrusted to groups of specialist teachers appointed by the Ministry of Education.

Distribution and financing

Both are the responsibility of the Ministry of Education.

Source: Document CERI/NT/84.02 (OECD)

B E L G I U M

Basic data

Total school population: 1 818 600 approx. (1982)

Education budget: 238 273 400 000 Francs (1982)
as percentage of GNP: 6.2%

Structure of educational system

Not available

	School population per level	Number of teachers per level	
			French-speaking area
Primary	780 408 (1982)	45 130	40 700
Secondary	818 611		60 800
Tertiary	219 591		9 300

Present situation

The situation is characterised by an uneven situation between the French and Dutch speaking areas. Although comparable in the (scarce) developments at the primary levels, the two parts of the Belgian educational system present marked differences at the secondary level, with the French speaking schools having done much less but preparing a full development plan for the future and the Dutch sector having done much more in terms of equipment and state investment but without any plan.

In the opinion of the educational authorities concerned (report of the Commission of the European Communities in 1983), the relatively slower development in French speaking Belgium is due to a combination of the relatively unstable political situation from 1977 to 1981, the budgetary repercussions of the general economic crisis and the recognised need to carry out a preliminary and thorough feasibility study taking into account the resources (equipment and trained teachers) which could realistically be planned for so as to avoid the kind of misguided practice which had dogged the introduction of audiovisual methods and programmed instruction in schools some 15 years before.

The problem of introducing informatics is far less one of hardware than one of staff training and staff receptivity to computer teaching.

PRIMARY EDUCATION

Hardware

10% of French-speaking schools have computer equipment, mainly financed by the schools themselves and the associations that support them.

Types of application

In the French-speaking schools the computer equipment is made available to the underachievers and mainly used for remedial education, back-up and extra teaching.

Teachers

In the Dutch-speaking areas, in-service training is organised by the Ministry of Education. Attendance is compulsory. Teachers learn how computers work and how to programme. 88 teachers were so trained in 1981-82 in courses of 6 4-hour sessions on the pedagogical applications of the computer and programming in Basic. No development plan exists. The trainers are university graduates that have taken an informatics course and no special teaching skills are required of them.

In the French-speaking area, in-service training is restricted to interested staff. It is given at a further training centre by a team of group-leaders. No specific training programme existed up to 1985 when the decision was taken to set up a training centre and seven pilot centres each with a number of satellite schools.

SECONDARY EDUCATION

Hardware

In the French-speaking area most of the secondary schools (age groups 14-16 and 16-18) have at least one microcomputer used either on an experimental basis as an aid in the teaching of a number of mainly scientific subjects, in management informatics or in the teaching of computing as a subject. The equipment is also used in the administrative management of the establishments.

In the Dutch-speaking area 25% of secondary schools have one or more microcomputers.

Financing

In the French-speaking area, the sources of financing are the Ministry of Education, state-aided bodies, the schools themselves, past students' associations and parents' associations.

In the Dutch-speaking area hardware is financed by the state. In 1982 30-35 million Belgian francs were spent on installing computers in secondary schools. This met the whole cost for state schools but only 60% of that of state-aided schools.

Types of application

Computer assisted instruction

In the French speaking area the fields of application are mathematics, physics and economics. Simulation programs are used in economics and industrial technology courses. Some courseware is also used for student assessment in the above disciplines (multiple-choice subjects).

In the Dutch speaking area, courseware is used to teach problem-solving, for drill and practice and for games.

Initial computer training

Some kind of introduction to informatics is generally included in the economics and social sciences curricula.

Teaching of informatics

In the French-speaking area there is an optional computer course as of the second cycle. Computer assisted instruction is used for certain subjects from this same level onwards.

Software production

In the French-speaking area, software is produced by the education authorities, firms, universities and teacher training institutions.

In the Dutch-speaking area, courseware is mostly produced commercially although teachers are encouraged to produce software for their own discipline.

Teachers

In the French-speaking area there are in-service computer training arrangements. The courses last 5 to 10 days (in state schools) and 10 to 15 days (in the tertiary sector).

Enrolment is voluntary but attendance is compulsory. The lecturers come from the "écoles supérieures d'informatique".

TECHNICAL EDUCATION

Teaching of informatics

In the French-speaking area courses are offered which last for about 30 weeks at the rate of some 7-8 hours a week for students specialising in informatics and 2-4 hours for the non-specialists.

In the Dutch-speaking area, some state schools run a 16-hour a week course in the 5th and 6th year of the secondary cycle.

In addition to these courses for informatics specialists, other schools offer more elementary courses (1 to 2 hours a week) during the last two years of secondary education.

TRENDS FOR THE FUTURE

In the French-speaking area, the Commission appointed to study the introduction of the new information technologies in education has set three main objectives:

- Every pupil leaving secondary education must have received basic training in computer studies;

- Holders of diplomas in computer studies (having successfully completed a short advanced course) are to be pooled into a reserve of teachers;

- Teachers in technical and vocational education must make an additional effort to include the new technologies introduced by the new industrial policy in the training they give.

For this purpose, the Commission has proposed a three-level programme as follows:

- The installation of a large computer at central level (the Ministry of Education's data processing centre);

- The installation of a number of medium-sized computers at certain strategic points in various regions with a relay/back-up role;

- The installation of microcomputers at local level for individual schools or groups of schools.

The Commission has also recommended that schools wishing to introduce the new technologies should be required to have the necessary staff and premises available, not just the hardware.

Lastly, it feels that the complexity of the problem of integrating the new information technologies in education makes it essential to set up a special body for the systematic co-ordination of teacher training, hardware programmes and the monitoring of experiments. This would be the Computer in the service of education network.

Primary education

A first development plan has recently been brought out in the French-speaking area. Parents' associations and teachers' unions seem to have no strong feelings about the new information technologies but reactions by pupils are, in general, very positive.

Secondary education

In the French-speaking area a development plan is in hand for the use of computers in teaching the mother tongue, economics, management, mathematics, physics and technical subjects (industry and craft trades).

Source: - Document CERI/NT/84.02 (OECD).
- Belgian Permanent Delegation to UNESCO, Note of 13 September 1985.

B R A Z I L

Basic data

Total school population: 26 695 600

Education budget: 963 546 million cruzeiros (1981)
as percentage of GNP: 3.8%

Structure of educational system: Not available.

School administration in Brazil is decentralised. Whilst the central government is responsible for higher education, secondary education is run by the States and primary education by the municipalities.

	School population per level	Number of teachers per level
Primary	22 522 756 (1981)	896 652 (1975)
Secondary	2 812 416	
Tertiary	1 360 427	92 546 (1975)

Computer policies

For many years now, Brazil has been concerned to formulate national policies for the development of computer use. Many different working papers, recommendations, standards and acts have been issued, the Ministry of Education playing a major role in the definition of policies in this field.

The national agency responsible for the development of computers is the Special Informatics Secretariat (SEI/PR) which defines national policy and coordinates its application.

One of the principles of national policy is import substitution - more a strategic than an economic consideration - and hardware required for the national market and deemed to be of strategic importance for reducing dependence on imports has begun to be produced in Brazil.

Whereas domestic consumption in 1976 was met entirely by imports, in 1985 there are more than 130 firms in Brazil meeting over 40 per cent of the domestic market and employing 15 000 people. Industrial production is focussed on small computers, simple in design and use and requiring limited investment. Even so, because, for economic reasons, the country lacks the necessary technological R&D capacity, it still has to rely on some - controlled - imports, generally confined to the big systems that the national industry cannot produce.

The integrated circuits and electronic components industry, on the other hand, is supported. A research programme recently launched at the Technological Centre for Informatics, which comes under the Special Informatics Secretariat, is designed to help towards the production of integrated circuits by the national industry.

PRIMARY AND SECONDARY EDUCATION

No precise information is available about the extent to which the computer has penetrated primary and secondary education. Two long-range forecasting studies are in hand, however, and should help to throw light on the situation.

CENIFOR, which comes under FUMTEVE (under the wing of the Ministry of Education and Culture), is about to complete a national survey on the location of hardware and the uses made - or that could be made - of it.

The FUMTEVE Centre of Educational Informatics is having R&D carried out, at the 5 universities(1) over which it has authority, on the use of microprocessors in the teaching process at primary and secondary levels.

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(1) The Federal Universities of Rio de Janeiro, Minas Gerais, Pernambuco and Rio Grande do Sul and the State University of Campinas.

Teaching of informatics

At the primary level, only a small number of private establishments in the big cities teach the rudiments of computer science - often based on the Basic and Logo languages.

At the secondary level, in state owned schools, only a very few technical schools give fuller courses in Basic and other languages. In private education, some schools are beginning to use the computer in the teaching of mathematics.

Teachers

In 1985, the education faculty of the Federal University of Rio de Janeiro was the only one to give courses for primary and secondary teachers wishing to specialise in computing.

HIGHER EDUCATION

Here there are some applications of CAI in various disciplines (e.g. the CAIMI programme at the Federal University of Rio Grande do Sul).

Research

In the EDUCOM project, the most important research relates to the use of informatics as a literacy tool (research on Logo) and the matching of hardware and software to the social and cultural requirements of the different regions (e.g. the research at the Federal University of Para in Amazonia).

Management applications

The Ministry of Education and Culture has set up a Central Informatics Office linked with the School Statistics Office coming under the Ministry's Secretariat-General.

Various non-interconnected information systems are responsible for data collection and management in the following fields:

- Administrative management and control.
- Academic management and control.
- Planning.
- Logistic support, documentation and libraries.

The degree of computerisation and decentralisation varies from system to system:

- Computerised data processing is general for administrative management, accounts, budgets, inventories and the management of administrative and teaching staff's pay, contracts and files and operates at both centralised and decentralised levels, part of the information being collected by the States which then aggregate the data before passing it on to the central office.

- Less use is made of the computer for the management of education itself, applications mainly concerning the administration of national examinations and sometimes the management of schoolchildren's records - more rarely school career guidance. Generalised use of computerised management in this sector is planned for 1985. All data concerning educational management is decentralised at State level.

- In planning, the computer is used for the management of human resources, statistics processing and research. Some incipient uses are reported in the field of the management of school materials and equipment, the analysis of school results, simulation of the educational system as a whole. The extension of data processing into these areas should be in effect by 1988 but difficulties arise because of the size of the country and regional disparities.
  This information sub-system is both centralised and decentralised at State level.

- As regards logistic support and documentation, a data base has been set up on teaching materials. It is entirely decentralised, being directly managed by the school establishments of which it is made up.
  For the libraries and educational documentation centres, however, the Ministry of Education has defined a "Bibliographical Information System" and another of a broader nature supervised by a Committee of Libraries reponsible to the Secretariat-General. In addition, data banks have recently been set up at central level for theses and computer resources and services.

Generally, school statistics are drawn up in accordance with the directives of the official statistics agency, the Brazilian General Statistics Institute which is responsible for the standardisation of data collection and processing.

Hardware and software compatibility is the responsibility of an Informatics Planning Section set up by the Ministry of Education to perform these functions of coordination.

In accordance with the recommendation of the National Informatics Policy, 60 per cent of the units used in educational establishments are microcomputers. A national packet switching network is currently being developed which should allow all existing computers to be connected up at the national level. Standard programs are already in use in the Ministry, in particular the SAS program for statistics and the ADABAS program for data banks.

The obstacles to the development of computerised management in the Ministry of Education include the lack of financial resources for the purchase of hardware, the weakness of the maintenance services, the incompatibility of some hardware, the under-utilisation of equipment (in terms of time), the lack of qualified staff and the differences in earnings as between computer workers in the public and private sectors. By 1985 the Ministry of Education reckons to have 500 computer specialists at different levels of qualification and 157 computers connected to a central processor.

FUTURE DEVELOPMENTS

Brazil is interested in cooperation at regional level with particular reference to the following areas:

- Development of a staff training programme.
- Institution of a cooperative software development programme.
- First steps towards an exchange network in the form of training sessions in firms in the industry.

Sources:

- Desarrollo de la informática en los sistemas de educación de paises de America Latina y el Caribe. OREALC/Estadisticas/36, Vol. I, March 1985.
- Informática y Educación - Simposio internacional, 30 April/4 May 1984, San Miguel de Tucumán, Argentina, 1985.

C A N A D A

Basic data

Total school population: 5 740 800 approx.

Education budget: 30 531 468 Canadian dollars (1984)
as percentage of GNP: 7.8%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I / II / III / IV
Cycle	Kindergarten / 1 2 / 3 / 4 5 / 6 7 / 8
	Pre-comp. / Compulsory / Post-compulsory
	Low. sec.
	High. sec.
	Vocational Technical Commercial / Teacher training
	University
	Teacher training
	Post-grad.

Compulsory examinations at end of cycles 4 and 8

	School population per level	Number of teachers per level
Primary	2 250 957 (1984)	331 700
Secondary	2 322 917	
Tertiary	1 042 595	58 800

Number of computers used in education

In most provinces, all secondary and most primary schools have at least one microcomputer. In 1984, over 53,500 microcomputers were in use in Canadian schools. There is considerable variation in the numerical pupil/microcomputer ratio geographically and from one school board to the next but English language schools in Canada averaged 1 computer per 87 pupils in 1984 and that figure should fall to 41 by 1986.

Current situation

The new technologies are present to a considerable extent in Canadian schools at both primary and secondary level although considerable variations exist across the provinces. Next to the more familiar use of the information technologies as a teaching aid and as a component of the curriculum, Canada has initiated a number of educational experiments, mostly but not exclusively at the secondary level, involving new and innovative uses of the new technologies such as satellite linkages, telecoms and television networks. Despite the sometimes considerable developments in equipment and educational design, Canada has still to solve the problems of formulating a coherent policy approach at both Federal and provincial levels and establishing effective co-operation and exchange across the provinces.

The fact is that the educational system is decentralised, each of the six provinces and the two territories having its own Ministry of Education responsible for the organisation and administration of education at primary, secondary and tertiary levels.

Government policies

Policies on the use of compuiters in education vary, therefore, from province to province. Most have formulated principles for including computer science, the development of computer literacy and data processing in secondary education curricula and some - but fewer - provinces have made provision for compuiter literacy to be included in primary school programmes.

The Ministry of Education in Alberta has set up a resource centre responsible for identifying and assessing courseware and the same province has selected a type of hardware and formed a central buying agency for schools. The province of British Columbia has likewise opted for and is promoting Apple microcomputers whilst New Brunswick has purchased a particular type of computer for its schools which is compatible with IBM systems.

The two biggest provinces, Quebec and Ontario, have very full policies on the subject. In Quebec the Ministry of Education intends, over the next five years, to invest 150 million dollars equipping schools (the target is to have 25 600 machines in primary and secondary schools by 1989), developing software production in French and promoting teacher training and research, whilst a specification drawn up by the Ministry of Education in Ontario for the production of a microcomputer to meet educational requirements has resulted in the manufacture of the ICON(1) which came on the market in 1984 and which schools buy with the help of a provincial government subsidy. In 1984 the same Ministry invested 5.4 million dollars in the production of software(2) but this figure will be increased to 10 million in 1986 which should make it possible to purchase the distribution rights of private sector courseware.

For footnotes (1) and (2) see next page

PRIMARY EDUCATION

The percentage of schools equipped with computers varies greatly across provinces. In December 1983, 30 per cent of primary schools in Quebec had at least one as did 45 per cent in Ontario (mostly COMMODORE and RADIO SHACK). In Ontario the education authorities developed an educational microcomputer called the ICON (see previous section). This is a 16-bit machine that can be networked and has a voice synthesizing facility and a 1024 K memory (3). For the first few years the provincial government will pay 75% of the cost of the ICON or any other machine meeting the same standards (up to now there is no other).

School boards are the principal source of financing for computer equipment. Some schools have used funds raised by the schools themselves, and by teachers, pupils and parents. In one case (Quebec) the funds have come through the Ministry of Education research grants. In another (Alberta) the provincial government has assisted schools purchasing hardware and software. The province of Ontario is about to complete arrangements whereby, for an initial period, school boards will bear only 25 per cent of the cost of recommended hardware.

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(1) Produced by the CEMCORP consortium (Canadian Educational Microprocessor Corporation) and to be marketed internationally under an agreement with the American computer manufacturer, Burroughs.

(2) Alongside the plan to produce special hardware, a development plan for courseware production was also launched in 1982 by the Ontario Ministry of Education (with finance from BILD, the Board for Industrial Leadership and Development). The plan is based on an appeal for proposals carried by the press and also addressed to universities. Out of the 500 projects sent in, 50 were selected for tailoring to suit CEMCORP systems. In addition, the CAN 8 authoring system developed by OISE and the National Research Council is fitted to the ICON. Compatibility with programmes run on IBM-PC is possible with a MS-DOS emulator. Currently some 30 educational programs adapted from versions for other systems and fifty produced for the ICON can be used.

(3) Alongside the ICON, CEMCORP has developed a mainframe computer, the LEXICON, which can control up to 32 ICON, Apple-II or IBM-PC computers on a local network. The ICON costs 2 500 dollars without a disc drive and 3 000 with. The LEXICON, complete with hard disc, sells at 7 500 dollars. The average configuration - one mainframe and three microcomputers - is offered to Ontario schools for 1 500 dollars, 25 per cent of which is met by the school board and the remainder by the Ministry of Education. In 1984, 400-500 systems were to have been installed on these terms, the target being one terminal for every 7 pupils by 1990.

Networks

Four provinces report the presence of interactive videotex units in elementary schools. They are however limited in number and of experimental use.

Manitoba and Alberta are the only provinces where elementary schools have access to specialised databanks.

Telematic networks are established in a school division in Manitoba (a network of micro-message and telephone lines) and in two Nova Scotia school districts (using educational channels of local cable stations to schedule, as required, programmes selected from an available bank of tapes).

Nova Scotia is also examining the possible use of four hours per day of satellite time made available by a commercial TV station to distribute programs to schools which could be recorded for later use.

APPLICATIONS

Computer assisted instruction

CAI programs for mathematics are used relatively frequently as are language, science, music and social science programs, though to a lesser extent. Some uses for lessons in writing and the development of formal thought are also found (5 provinces). CAI is also used for teaching the graphic arts and for games in British Columbia, Ontario and Quebec. Logo is researched at Queens University and is introduced to varying extents in schools in three provinces: Ontario, Nova Scotia and Alberta.

Although the wider use of CAI would seem desirable, its growth is impeded by the lack of high quality courseware and the small number of computers available in most establishments.

Management

Increasing use is being made of computers for administrative and educational management purposes (pupil management, performance monitoring, library management, etc.).

Teaching of informatics

General computer courses are given in only one province (British Colombia). Generally speaking, provinces feel that while it may be possible to teach computer science as a separate subject at the elementary level it is not desirable to do so. They therefore recommend that it be confined to the rudiments of informatics and that these be presented in lessons on certain subjects in the curriculum.

Some provinces, but not all, have introduced, or are considering introducing, computer literacy lessons in their primary schools and since September 1983 Alberta has been piloting a 30-hour unit in computer literacy at grades 4, 5 and 6. In other provinces computer awareness lessons are integrated into other subjects, such as social studies.

In general, computer teaching is largely used to familiarise schoolchildren with the computer. The target group is all pupils and the "tail-ends" - the gifted (especially Quebec) and the underachievers - depending on the province.

Software

The emphasis on the creation of courseware directly by a ministry of education varies considerably across provinces. Active provinces in this area are Alberta (software produced by the teachers of the correspondence school), Ontario and, to some extent, British Colombia. Reference has already been made to the initiatives of Ontario and Quebec in this area.

Some provinces provide training in courseware for teachers, some leave the initiative to private industry and others make the universities and teacher training colleges responsible.

Some instances are reported of inter-provincial cooperation in the field of information on and evaluation of existing courseware.

Expenditure by Canadian schools on the purchase of software is forecast at over 10 million dollars in 1985-86 and that on hardware at over 70 million for the same period.

Languages used

A very wide variety of machine and authoring languages are used in software production the most widespread being Can-8 and Natal, developed in Canada. Plato, Basic, Fortran, Cobol and Pascal are also used. There is an increasing demand for languages like C and Logo which do not require any prior instruction in programming techniques.

Quality control

The quality of currently available courseware is apparently inadequate. The general provincial concensus would characterise available courseware as poor or spotty.

The Quebec Ministry of Education has developed a series of instruments for use in verifying the quality of courseware and some colleges have set up courseware selection and evaluation committees and taken on specialist advisers for the selection of products and their adaptation to educational needs. In British Colombia, for example, the Provincial Education Media Centre puts out a monthly publication called Microware which includes critical appraisals of 4-5 000 products that can be used at all levels, from primary to tertiary. In Alberta, a courseware evaluation centre has been set up which issues lists of recommended products. The authorities in two other provinces bring out approved software lists and those in two others are considering doing the same.

Diffusion

In most cases courseware is distributed on a commercial basis and schools have to buy it. In Ontario, however, a special service run by TV Ontario (Ontario Educational Software Service or OESS) distributes software. OESS writes and issues a catalogue but also prdoces diskettes and documentation about them.

Teacher training

Most provinces have instituted workshops, seminars and short courses for teachers, the training being given mainly by universities, colleges, the school administrations, teachers associations, teacher training colleges and computer manufacturers. It is believed that by 1984 37 per cent of Canadian teachers had received general preliminary training in the use of computers in the classroom. In British Colombia, for instance, computer suppliers train district staff who in turn train local school staff in the use of the computer. In Ontario, the province, by way of TV Ontario offers teachers the opportunity to participate in the educational television network's Academy on Computers in Education, which constitutes an integrated learning system centering on a 12-part TV series entitled "Bits and Bytes". The Academy is marketed to all sections of the Ontario educational community with the support of the Ontario Teachers Federation.

A variation of the same series called "Octopuce" has been broadcast in Quebec since 1983. So far 12 000 people, many of them teachers, have enrolled in the related correspondence course. Additionally, a December 1983 survey has indicated that 25 per cent of the 25 000 teachers had had elementary training of between 10 and 45 hours. A further group of 11 teachers had done more intensive training amounting to 180 hours over a period of five months. Another 1 500 teachers had enrolled in university courses.

In Ontario, teachers completing a series of three courses offered by the education faculties of several universities are awarded a specialist's certificate.

Montreal university in Quebec gives refresher courses and the University of Quebec in Montreal (UQAM) introduced a "certificate for the pedagogical use of the computer" in 1984. Lastly TELUQ (the Quebec teleuniversity) has set itself the target of training 6 000 teachers between 1983 and 1985, 50 per cent for primary and secondary schools and 50 per cent for colleges.

SECONDARY EDUCATION

The proportion of establishments having computer equipment varies widely across the provinces, ranging from 7 to 90 per cent.

Computer equipment is purchased by the joint efforts of the provincial Ministry of Education and the local school boards.

Networks

In Ontario, a "Telidon" project in which a hundred teletex and videotex terminals are installed in schools, young people's employment bureaux and libraries is under way. Users of the terminals are able to consult, at will, certain of the 60 000 Telidon pages which give up-to-date information in French and English on careers and training opportunities. A directory of government departments is also available via the network.

Types of application

In secondary schools, computers are principally used to teach the rudiments of computer science and programming.

Computer assisted instruction

The most widespread uses of CAI are in the teaching of business management, accountancy and data processing. Although all subjects are covered, the most usual fields of application are mathematics, science, social studies, languages, geography and music.

Administrative and educational management

Increasing use is being made of computers in administrative and educational management for student guidance and management, monitoring of performance, etc.

Networks

Ontario has set up a computer network linking the Ministry of Education with some sixty school boards. Called Educational Computing Network of Ontario (ECNO) it is primarily used for administrative management purposes (staff pay, financial management, pupil management, timetables, school career guidance, etc.). The Ministry is considering extending the network to all school boards in the province and applying it to other purposes such as:

- accessing the Ontario Educational Software Service and downloading courseware;
- accessing databases such as ONTERIS at the Ministry of Education which administers documents on educational research, programmes and courses, TV Ontario's EDUTEL which contains, inter alia, a Telidon version of the school career guidance system and other public and private databases with an educational slant.

Teaching of informatics

General computer science courses are offered in the business and technology area. Not all provinces appear to distinguish between generalist and specialist computer science students. Students spend from two to 15 hours a week on computer studies and the total hours of instruction range from 50 in Saskatchewan to over 100 in Nova Scotia. Basic courses may start as early as grade 9. In Ontario a specific "Computer studies" programme has been prepared for secondary schools consisting of four separate courses: introductory computer studies at the intermediate level and computer science, computer technology and data processing at the higher level.

Information on informatics

Information about computing is part of elementary computer lessons and programmes and also of other subjects such as social studies. This generally deals with the history of computing and its implications for society, the purpose being to awaken the student's critical faculty with regard to the computer.

Software

For production and diffusion see under "Primary education". As regards standardisation the Alberta Ministry of Education, which has standardised the Apple format for all approved courseware, is the only authoriy to have taken a policy stance in this area.

Teachers

With regard to teacher training some provision exists at both initial and in-service levels. Both are usually voluntary. The percentage of teachers trained varies from province to province. In Nova Scotia between 20 and 30 per cent of teachers undergo initial training and in Quebec 4 000 secondary teachers (about 13 per cent of the total) have taken the general introductory course lasting from ten to 15 hours and eleven have taken the related in-depth training course of 180 hours. About 3 000 more follow university courses on the subject on a voluntary and independent basis.

HIGHER EDUCATION

In 1982, the Federal Government set up a Skills Growth Fund to provide for the provincial financing of the institution, development or conversion of the necessary resources for the training of qualified staff in the field of industrial and commercial techniques. Since that date, the Fund has distributed 191.5 million dollars, mainly to the community colleges. Among other things, these sums have enabled colleges to be equipped with computer hardware and software for computer assisted design and training in computerised production and manufacturing techniques.

Hardware

It is estimated that over 2/3 of colleges are equipped. A survey of 131 colleges in 1984 produced the following information:

Is CAI on your campus available on	Response breakdown in number and per cent
A. Microcomputers only?	23 37.7
B. Mainframe computer only?	7 11.4
C. Both micros and mainframe?	30 49.3
D. Other	0 0.0
E. No answer	1 1.6

Source: Smith, Ron. Computer-based Delivery Project, Charlottetown, Holland College, 1984. Unpublished study.

The type of hardware most frequently used in the colleges in the English-speaking area is the Apple. Those most used in the French-speaking area are the Commodore and the TRS-80. All colleges use a wide variety of machines but recently the choice seems to favour the IBM-PC and PC-compatible micros.

Types of application

Computer assisted instruction

Although many colleges say they are interested in the use of computers in other disciplines apart from computer science itself the relevant applications are relatively slow in developing and the growth of CAI at this level of the education system is inhibited by budgetary constraints and the lack of software of the right quality.

Some colleges have introduced courses on CAD and CADM in their curricula.

Educational management

Applications (management of programmes, tests and examinations, organisation of courses, monitoring of students' progress) exist in some establishments. Particular attention is given to this type of application as a means of offering courses to people at home or in their working environment.

Teaching of informatics

In response to the market's requirement for qualified manpower in the technological industries, over 2/3 of Canadian colleges offer computer courses (programming, utilisation, systems analysis, repair and maintenance).

Software

Some colleges produce their own software particularly in Quebec where the need for French programs is most acute (in 1983 the Directorate-General for Educational Resources launched a programme for the production of software by colleges). Generally this is done by teams of content specialists, programmers and educationalists.

Teachers

Several colleges have equipped themselves with the hardware and other resources necessary to enable their teachers to teach themselves but other facilities are also available such as courses outside the colleges and training seminars.

SPECIAL CONTEXTS

COMPUTERS AND DISTANCE EDUCATION

Many educational establishments in Canada provide distance education services. The specific examples referred to in this section have been selected from among establishments using computers for data management and, more particularly, for communicating with students. The educational context and the role played by the computer are described.

The Open Learning Institute

The OLI was set up in British Colombia to "fill as many of the gaps in the present system of provincial post-secondary education as possible" and to "avoid unnecessary duplication of effort and resource use through cooperation and collaboration". The OLI offers part-time programmes for adults leading to first cycle diplomas in the arts and sciences and in administration, basic adult education programmes, end of secondary studies programmes and vocational and technical training programmes. In March 1984 the OLI had 10 400 enrolled students and was offering 100 courses with diploma credits plus 60 vocational and technical courses. The first cycle programme allows students to transfer practically all their credits to the three universities in British Colombia.

The Open Learning Institute is part of the International Universities Consortium in which there are 30 American universities, Athabasca University and the British Open University. This gives the OLI access to the Open University's courses and those designed by the Consortium.

The Open Learning Institute has developed highly perfected systems for running students files for use by internal staff and also teachers and advisers. Using on-line terminals in regional centres the information is available everywhere which means that students' requirements can be met speedily and efficiently. The OLI CAI programme includes evaluation commentaries and catching up and revision lessons.

OLI students are able to enrol for an introductory computer course designed to familiarise them with the rudiments of the operation of computers and their applications. Students are allowed to borrow a Radio Shack TRS-80C microcomputer which they can either return to or buy from the OLI at the end of the course.

TV Ontario's "Microcomputers and learning"

In October 1982, TV Ontario brought out a multi-media package called "Microcomputers and learning" primarily designed to provide primary and secondary teachers with a basis of practical knowledge on computing and its educational applications. The package consists of 12 course units embracing television broadcasts, documentation to accompany the broadcasts, practical work and a computerised response management system (RSVP - Response system with variable prescriptions) initially developed by the Miami-Dade Community College in the United States.

The functions performed by these programs are as follows:

- managing the personal file of every student enrolled;
- handling students' replies to the multiple-choice questions they regularly have to answer in the framework of each course.

The computer programs thus enables TV Ontario to send out, automatically, individual replies (letters), based on the analysis of students' replies to the questionnaires sent them, which comment on students' answers, clarify concepts which appear not to have been assimilated and suggest further avenues of research depending on the student's objectives, his academic level, occupation, place of residence, etc.

Altogether the course makes up 35 to 75 hours of work over a period of 12 weeks.

When the course was launched in 1982, TV Ontario was reckoning on about 10 000 enrolments for the whole of the course and for two successive broadcasts. A French version has been produced with the Ministries of Education of Quebec and New Brunswick.

Sources:- The microcomputer in the teaching-learning process. The Canada context (Unesco Joint Studies in the Field of Education - Study 3), July 1984.
- Document CERI/NT/84.02 (OECD).
- ANTEM letter No. 1, November 1984 (Paris, CESTA).
- A provincial policy response to the high-tech impact on education. Paper by D.A. Penny, Assistant Deputy Minister, Ministry of Education, Ontario, Ottowa, Oct. 27 1984.
- Gary Scott, The Pepper Wood El-Hi Report on Computers in Canadian Education, Pepper Wood Inc. Box 185, West Hill, Ontario M1E 4R4.
- Statistics Canada, Education in Canada. A statistical review for 1983-84, Catalogue 81-229.
- Statistics Canada, Advance Statistics on Education, Catalogue 81-220.

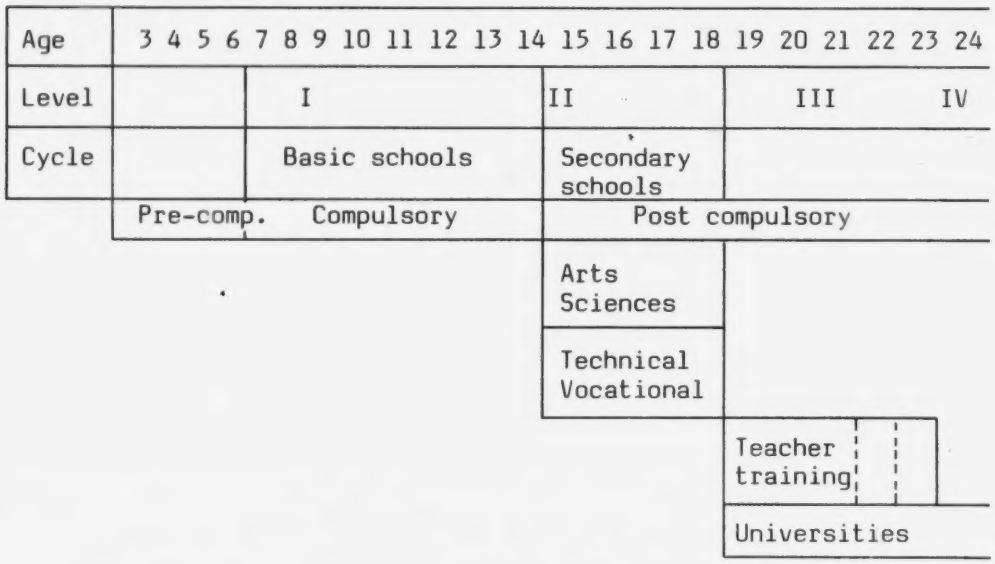
C H I L E

Basic data

Total school population: 2 779 480

Education budget: 65 336 340 000 Pesos (1982)
as percentage of GNP: 5.8%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	2 092 597 (1982)	62 746 (1982)
Secondary	565 745 (1982)	29 567 (1975)
Tertiary	121 138 (1982)	10 372 (1982)

Informatics policies

The political will to define development plans for informatics has been in existence since the 1960s but few of these policies have been put into effect. At the moment a government representative on the National Commission for Scientific and Technological Research is responsible for developing a national policy on computers. The Concil of Rectors has also formed a Special Commission on Informatics. The two bodies are responsible for defining national policy and coordinating action.

As regards the local production of hardware, some of the big universities are running research activities but private firms are the main source. Plett Sistemas, Miramar Computer Center and Newtec plants all assemble Apple-compatible microcomputers from imported components. TUCAN Ingeniera has designed a Chilean IBM-PC-compatible microcomputer called CONDOR scheduled to come on the market in 1985.

Economic factors are mainly responsible for inhibiting the development of computer use in the country, particularly in the educational system. According to the sellers of hardware there are probably, for the whole country, about 7 000 computers in use in one way or another for educational purposes: home computers used by children, computers in schools and universities and hardware in technical training centres and in private firms' own training centres.

PRIMARY AND SECONDARY EDUCATION

There are no reliable data available on the number of computer-equipped schools (primary and secondary) but it is known that computer awareness is gaining ground among teachers as a body and that some private firms have tried to promote sales through the schools. However, the economic recession and the high cost of computers are inhibiting their introduction into schools.

The following table gives a very approximate estimate of the number of computer-equipped establishments:

ESTIMATED COMPUTER RESOURCES IN PRIMARY AND SECONDARY SCHOOLS

Level	Type	Total No. of schools	No. of computer-equipped schools	Percentage of total
Inter-mediate	Infant sch.	189	4	2
	Municipal	386	19	5
	Private, state-aided	308	6	2
	Private unaided	144	43	30
Basic	Private unaided	334	17	5
	Other	6 530	33	0.5
	TOTAL	7 891	122	

Note. From the Superintendencia de Educacion, quoted by Jara A. Contardo H. The original figures are given in educational units. The correction factor used to give the number of establishments is 0.74, which is correct at aggregate level and roughly the same for all levels.

Source: La informática en la administración y planificación descentralizada de sistemas educacionales en America Latina. El caso de Chile. OREALC/Estadisticas/36, Vol II,

The most wide-spread configuration seems to be the computer room with 3 or 4 microcomputers, four screens and one printer.

SECONDARY EDUCATION

Teaching of informatics

For schools with computers, activities are optional and centered on learning how to programme with pupils in groups of 20 per computer room. At the end of the course the children present an individual or group project. The languages used for these courses are Basic and Logo. Some applications involving the use of statistics handling and word processing software. Higher education computer students are sometimes associated with school activities.

TECHNICAL EDUCATION

Some very few technical secondary schools offer courses in programming.

HIGHER EDUCATION

The use of computers in higher education (not including the teaching of computer science itself) relates instruction in programming to the technical courses (economics and architecture, for example). Some experiments are also being carried out in areas such as the chemical industry (computer assisted hardware manufacture), teacher training (production and evaluation of software) and pharmacy (CAI).

EXTRA-MURAL

There is an unknown number of private institutions - mainly dependent on the sellers of hardware - offering computer courses for young and older children.

SOFTWARE

A few private firms, including Microdata System, ROARCO, Inforcentro, Videomática, etc., produce CAI software and learning games and also management software for educational establishments but for the moment in very limited quantities.

Some universities like the Santiago y Catolica de Valparaiso also produce educational software (on mathematics, for instance) but in minute quantities. There are no overall data on the number of programs available.

TEACHERS

As yet there is no systematic teacher training in this field. There is just one establishment with 80 places for training teachers of "mathematics and informatics" (see under Research below).

There is also a mobile training facility (travelling computer room) with space for about 20 people which goes from town to town organising workshops and practical courses. About 250 primary and secondary teachers have taken part in this form of training so far.

In fact, most teachers that use the computer have learned of themselves, taking the courses offered by the sellers of hardware. About 2 per cent of teachers may reasonably be estimated to have been trained in this way.

In 1985, however, the CPEIP had an appropriation of 1 600 dollars to launch a 4-year teacher training programme.

RESEARCH

The two avenues of research that have been followed in Chile are:

- the influence of the computer on cognitive development, and
- the evaluation of computer applications in the teaching/learning process.

The former subject gave rise to very little research in the private institutions and no results have yet been published. The latter prompted more research papers which were presented at the meeting on "Education and informatics" organised by the CPEIP in 1984(1).

An example worth quoting is the research programme launched by the Study group on the teaching of mathematics at the Santiago university under the following main headings:

- Design and development of learning systems. The object of this project is to work out a system for learning mathematics in which the child has a central role.
- Programming in logic. Study on causal logic and on the Prolog language. Development of a Spanish version of Micro-Prolog. Development of educational applications.
- Social psychology and the teaching of mathematics.
- Computer policies in Latin America. Comparative analysis of policies followed in the region.
- Teacher training. Study of training courses introduced at the university: first cycle "teaching mathematics" course launched in 1976 under the auspices of the OAS and with the technical assistance of the University of Colombia (New York). The programme trained 318 teachers between 1976 and 1985.

Alongside its teacher training activities, the Education Administration Centre at the University of Concepcion also conducts research on the design and development of hardware for the teaching of computer science.

MANAGEMENT APPLICATIONS

Since 1976, changes in the government's administrative structure have given the municipalities direct responsibility for school establishments that used to come under the Ministry of Education while technical schools are now run by non-profit-making organisations. So there are now two levels of educational administration: (a) the Ministry of Education and its 13 regional offices representing the Ministry in the provinces and (b) the municipalities which are independent of the Ministry.

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(1) Resumenes de los trabajos y ponencias presentados al Encuentro sobre educación y informática. CPEIP, Serie Estudios No. 116, May 1984.

At the Ministry of Education

Under the heading of administrative management, the computer is used for the management of pay and contracts for staff not placed at the disposal of the municipalities. It is also hoped to computerise accounts, budgeting and inventories by 1988.

As regards educational management, the computer is only used for national competitive and other types of examination (1), but it is hoped to computerise the management of curricula by 1988.

With regard to planning, statistics and censuses have already been computerised. A cost-effectiveness project has been developed on the basis of databanks on primary and secondary education and pupils which is used for establishing indicators for dropping out and failure at school and the efficiency of the educational system.

Some applications relate to the planning of human resources and the simulation of the educational system.

In the CPEIP (Centre for educational improvement, experimentation and research), computer facilities are used in research.

Applications in the documentation field are as yet experimental: bank of educational tests and aids and assistance in library management. The biggest computer-based project here is the library network plan piloted by the National Library. An educational resources bank has also been formed in the CPEIP and another databank on development has been set up by the CONICYT.

Only one of the Ministry's regional offices has yet computerised its data processing.

In the municipalities

Here the situation is extremely varied. A survey of the big cities shows that:

- Practically all municipalities use computers to administer the pay of both teaching and administrative staff.
- About 50 per cent of them use the computer for managing their financial and accounts systems.
- About one-third of municipalities have computerised their staff administration, but only 17 per cent have a statistical system.

At the Ministry, administration, planning and documentation applications are based on hardware owned or leased by the government but educational management work is sub-contracted to private firms.

Practically all the municipalities sub-contract.

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(1) E.g. the entrance examination to the University of Chile.

The co-existence of two systems, one centralised (Ministry) and the other completely decentralised (municipalities) should argue for the formulation of common policies and standards but so far, in spite of the efforts in that direction by the National Planning Office (ODEPLAN) no concrete measures have yet been taken for the standardisation of archives, databanks and so on. The absence of an integrated data system makes the collection and utilisation of data at the local level very difficult. There is a project for the harmonisation of the hardware acquired by regions and communes and the Ministry of Education has had a preliminary study made of the cost-effectiveness of the microcomputers used for administration which, at the moment, are extremely heterogeneous (in makes and characteristics).

Other obstacles in the way of the development of computer use in the running of the educational system are the lack of budgetary resources for the purchase of hardware and the difficulty of recruiting qualified staff, attracted by the higher pay obtainable in the private sector.

The Ministry of Education's computing centre now employs 31 people; this is to be increased to 41 by 1988.

FUTURE DEVELOPMENTS

Chile would like to participate in an exchange network at the regional level with priority going to the exchange of people. It would also like to have assistance in the production of educational software for courses in Spanish, mathematics, natural sciences, history and geography.

Recourse to international aid is being considered for the training of computer specialist teachers abroad and for the development of research.

Sources:

- Desarrollo de la Informática en los sistemas de educación de paises de America latina y el Caribe, OREAL/Estadisticas/36. Vol. I.
- La informática y los recursos computacionales en la administración descentralizada del sistema de educación en Chile, OREAL/Estadisticas/36, vol II.
- Informática y Educación: enfoque adoptado por el Grupo de Estudios en educación matemática de la Universidad de Santiago de Chile. Working paper produced for the Regional colloquoy on informatics in education (Caracas, 5-9 Aug 1985)..
- La computación y los sistemas de información administrativos: sus aplicaciones in educación. Prof. Jorge Marquez Yevenes, Universidad de Concepcion, Centro de Administración educacional, Aug 1985.

C H I N A

Basic data

Total school population:	Not available
Education budget:	Not available
as percentage of GNP:	Not available
Structure of educational system:	Not available.

COMPUTERISATION POLICY

The target year for the Chinese government's objectives is 1990: development of microcomputer applications in big enterprises, higher education establishments, certain medium enterprises occupying key positions in their sectors and research institutes; equipping of certain primary and secondary schools in urban areas and some primary schools in rural areas..

Present situation

Although the Ministry of Education had decided to introduce learning about computers in primary schools in 1984, action has been experimental and confined to certain pilot establishments.

In second cycle secondary education there are optional computer courses of 45 to 100 hours per cycle. In the first cycle computing is an extra-mural, extra-curricular activity.

APPLICATIONS

Training mostly relates to the role of computers in society and learning Basic.

CAI programs have been developed experimentally in various disciplines: mathematics, physics, chemistry, geography, etc.

TEACHER TRAINING

This is to be givem by higher education establishments (universities and colleges) for both initial and in-service training of primary and secondary teachers.

FUTURE DEVELOPMENTS

On the basis of experience in the pilot schools, research is to be conducted on the role that the computer can play in the teaching of all subjects and on their possible contribution that computers can make to education.

Source: Final report of the third Asian seminar on educational technology in Tokyo, 26 Sep/2 Oct 1984 (APEID 1984).

C O L O M B I A

Basic data

Total school population: 6 228 661 (1982)

Education budget: 51 777 416 000 Pesos (1981)
as percentage of GNP: 2.6%

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	4 076 200 (1982)	131 745 (1982)
Secondary	1 816 628 (")	90 171 (")
Tertiary	335 833 (")	38 464 (")

Policies and projects

In January 1983 the Colombian Government set up a National Informatics Council, reporting directly to the President's office, in order to meet the requirement for a coherent informatics policy. The remit of the Council is to bring together the various government bodies with responsibilities in this field so as to ensure the even diffusion of informatics throughout the country and to decide on national priorities in the light of the resources available.

The Ministries of Education, Communications and the Plan, and the DANE (National Administrative Department of Statistics) are all represented on the Council one of whose fields of activity is that of databases where its responsibilities are the coordination of government activity and the democratisation of their diffusion). In particular it is promoting the development of a national data transmission network (to be operational in 1986) and access to international networks.

Colombia currently produces no software and one of the aims of the Council, therefore, is to develop a national software industry. Draft legislation on intellectual and industrial property and the tax treatment of software production is in preparation.

Although there exists a plan, originating in the President's Office, for the manufacture of 20 000 microcomputers, it has not so far materialised and the country has no domestic hardware production. One of the reasons is the lack of financial resources (in terms of investment by industry and consumers' purchasing power); conversely, the country does seem to have the necessary human resources to build up a computer industry.

PRIMARY AND SECONDARY EDUCATION

No informatics teaching is dispensed in primary and secondary schools or in technical education establishments but a small number of private schools use computers as an aid to learning.

A pilot project in which Computer appreciation centres were set up in nine towns(1) is now being evaluated under the reponsibility of the Latin-American Centre for Human Resources and Informatics(2). Each centre was equipped with 10 microcomputers, a printer and standard software (including Logo in Spanish) and opened to pupils from primary and secondary schools for short introductory sessions and to interested children ouside school hours.

Another experiment is under way at the Informatics centre of the President's Office where a computer room has been opened for children.

Software

There is no national production of software.

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(1) Paso, Cali, Neiva, Pereira, Medellín, Monteria, Baranquilla, Bucaramanga, and Bogotá (3 centres in this city).
(2) See "Networks" below.

Teachers

No data are available on informatics training for teachers.

VOCATIONAL TRAINING

Informatics at the National Training Service (SENA)

The SENA, set up in 1957, comes under the Ministry of Employment and National Security. It is a public, decentralised institute with a Directorate-General and 19 area offices. It is financed by a percentage levy on wages in the public and private sectors and by training contracts with other private and public bodies.

The training it offers comes under five headings: popular promotion programmes, training at Specialised Centres, in-firm training, distance training and scientific and technical popularisation campaigns. In 1984, drawing on its 11 years experience of the use of computers in administration, SENA added informatics to its programmes.

After a few experiments launched in 1984, SENA embarked on the systematic installation of computers in its area offices in which "Computer centres" were opened equipped with a total of 173 machines and standard software. The same year it decided that informatics was to take priority in its future activities and set up a pluri-disciplinary working group to be responsible for coordinating the various developments put in hand. These focussed on the following:

- Study of the impact of computers on the production sector:
  - Research in collaboration with the Economic Development Research Centre of the University of the Andes on the impact of informatics in industry.
  - Research led by the Valle area office in collaboration with the local university on prospects for computerisation of local firms.
  - Informatics and tertiary activities: diagnosis of training requirements in the sector.
- Informatics as a subject to be trained in: definition of contents of courses meeting the needs of the industrial and tertiary sectors. Creating awareness among employers.
- Computers and the learning process:
  - Analysis of the educational applications of computers.
  - Pilot experiments on the production of software usable for computer managed instruction (CMI), computer assisted instruction (CAI in the tutorial mode) and the creation of exercise and test data banks.
- Training of SENA staff and particularly for those teaching accountancy, banking methods, secretarial skills and electronics.

INFORMAL EDUCATION

Networks

The aim of the Colombian "Diffusion of informatics" programme run by the Latin-American Informatics Centre is to popularise computer applications throughout the whole population, so that, ultimately, the infrastructures installed will constitute the basis of a "public informatics service".

In 1985 the network consisted of 12 "centres for the diffusion of informatics" in nine of the country's big cities. It is planned to open five further centres in 1986 plus a number of "community centres" in rural areas. The public has free access to every centre each of which is equipped with 12 or so personal microcomputers, several printers and a specialised library.

When the national data transmission network is operational (in principle in 1986) the centres will be interconnected and provide access to the international networks. The Diffusion Centres network collaborates with most Colombian universities and many primary and secondary schools.

RESEARCH

One of the best known research projects concerns the use of Logo in rural areas. This was a six-months project (it is now in process of evaluation) mounted jointly by the SER research institute with finance from the National Development Projects Assistance Fund (FONADE) and the President's Office literacy programme CAMINA.

In the university milieu, a group of teachers in the university of the Andes has set up a Research Unit on Computer Assisted Instruction which has launched several pilot projects at the university including:

- Development of computer aids for learning programming (Karel language compiler and Karel environment simulator, simulation of the internal workings of a computer), computerised language laboratory for learning English.
- Teaching aids (building up of an exercise data bank; system for generating tests and examinations and for checking answers).

MANAGEMENT APPLICATIONS

Management applications are all at the central level, namely the Ministry of Education and bodies for which it is responsible like the Colombian Higher Education Institute (ICFES) and the National Training Service (SENA).

A project with the title "Integrated Educational Information System" is also being developed in the National Administrative Department of Statistics (DANE) which is one element of the National Plan for the development of rural and low density areas.

In the Ministry, computers are used for administrative management (accounts and staff pay), educational management (records of students in higher education, administration of national examinations) and planning (statistics and research). The Ministry is also working on an information system on the legal and legislative aspects of education and on informal education.

- In the ICFES aplications are largely similar to those in the Ministry of Education.
- The SENA is to develop applications in the near future for the management of curricula, research and educational databanks.

Steps are being taken to bring about the gradual decentralisation of data collection and processing, the main step being to set up, via the SIED, a national network based on regional centres. To that end, efforts are being made to introduce standardisation, e.g. in the database field, by the definition of a Colombian Bibliographical Information System (SCIB) promoted by the ICFES.

In hardware the preference is to use microcomputers on the spot or connected to high capacity mainframe units.

The biggest problems are those of the importation of hardware (shortage of foreign exchange), weakness of the maintenance services, incompatibility, lack of suitable programs, shortage of qualified manpower and the big gap between specialists' earnings in the public and private sector.

In 1985 the National Ministry of Education and the central agencies that come under it had 27 computer specialists at various levels of skill and five occasional outside consultants. By 1988 the requirement is expected to be 80 internal specialists and as many outside consultants.

FUTURE DEVELOPMENTS

A report by the "Colombian Mission on the Development of Electronics and Informatics"(1) dated July 1984 recommends the installation of microcomputers in all education establishments and the introduction of computers in distance education systems and literacy programmes and particularly in technical education and vocational training.

In the field of regional cooperation, Colombia would like there to be exchanges of information on experiments carried out and exchanges of software and it would like to see the development of regional projects for the production of programs particularly those for primary and secondary education.

Sources:

- Desarrollo de la informatica en los sistemas de educación de paises de America Latina y el Caribe. OREALC/Estadisticas/36 Vol. 1, Mar 1985.
- Grupo investigacion sobre educacion apoyada con computador, Universidad de los Andes, Bogota, July 1985.
- La informática en la formacion profesional en el servicio Nacional de aprendizaje. Documento preparado para la consulta regional sobre aplicación de la informática en educacion. Caracas, 5-9 Aug 1985.

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(1) Republica de Colombia, Mision Colombiana de Eletronica e Informática, Informe al Señor Presidente de la República, Bogota, July 1984. dupl.

C O S T A R I C A

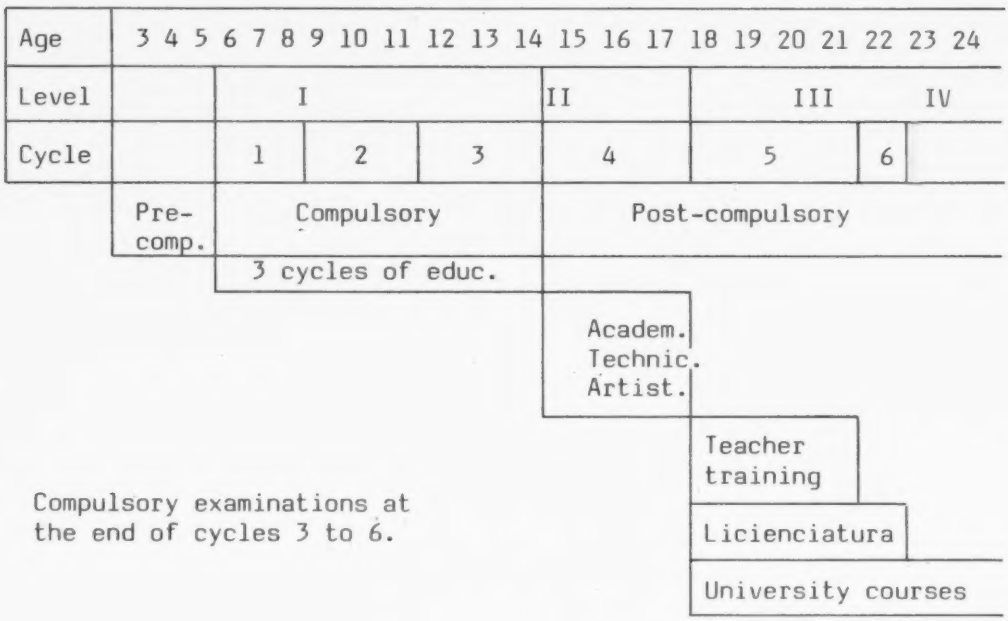
Basic data

Total school population: Not available

Education budget: Not available

as percentage of GNP: " "

Structure of educational system:



Compulsory examinations at the end of cycles 3 to 6.

	School population per level	Number of teachers per level
Primary		
Secondary	165 374 (1982)	6 540 (1982)
Tertiary		

SECONDARY EDUCATION

On overview of the computer situation in secondary education in Costa Rica can be obtained from the following table:

General summary of the use of computers in secondary education in Costa Rica

General info. / Type of college	Total	Total enrolment	Number of colleges having computers	Number of computers	Use made of computers			
					Recreation	Teaching aids	Programming courses	Admin
Private	26	9 067	8	72	-	1	6	1
Semi-official	16	8 451	1	2			1	
Public	123	103 631	1	10*			1	
Total	165	121 149	10					

* Includes the 10 computers of the Programme of the Ministry of Public Education.

The only use of computers as an educational aid referred to in the above table relates to the project developed by the Instituto de Educacion Integral. This is a private secondary establishment which takes in young people having difficulty fitting into the traditional school system. To meet the particular needs of this kind of youngster the institute, first a research institute, is running an experimental educational project and developing new teaching methods: individualised instruction, involvement of pupils, teachers and parents in the educational process, use of computers as a learning aid.

The Institute uses Commodore 64 microcomputers and produces its own programs (in Pascal). The computer is designed as an aid to gaining factual knowledge of mathematics, physics, chemistry, social studies and English but the Institute also offers a course in programming (using the Logo language in particular) and gives lessons on the social impact of the computer.

The "research" aspects of the project mainly relate to the observation of behaviour (of teachers and pupils) and the evaluation of teaching and curricula: learning rates, structures of mistakes made by pupils, types of questions put, evaluation from the educational psychology standpoint and evaluation of learning performance with a view to adapting or changing the curricula.

Source:

- Instituto de Educacion Integral/Lic. Otto Silesky, J. Miguel Solano. Instauracion de un sustema de tecnologia instruccional. Consideraciones sobre el uso de la informática en la educación. San José, Costa Rica, 1985.

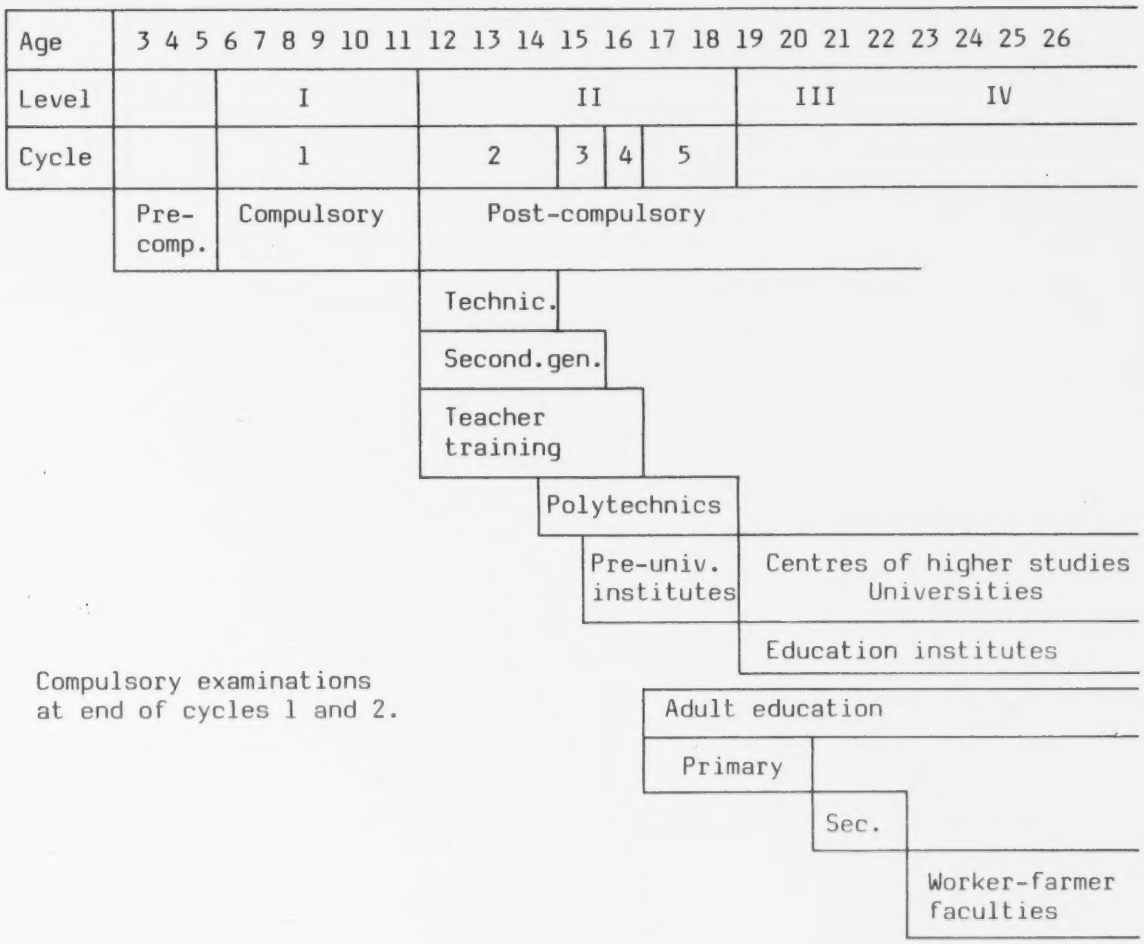
C U B A

Basic data

Total school population: 2 554 037 (1982)

Education budget: 1 457 100 000 Pesos
as percentage of GNP: 6.3%

Structure of educational system:



Compulsory examinations at end of cycles 1 and 2.

	School population per level	Number of teachers per level
Primary	1 363 078 (1982)	83 358 (1982)
Secondary	1 017 556 (")	88 199 (")
Tertiary	173 403 (")	12 222 (")

Informatics policies

A national body, the Instituto Nacional de Sistemas Automatizados y Tecnicas de Computacion (INSAC) is responsible for the development of informatics in the country and, with it, the Ministry of Education has defined specific working principles with regard to the relations between education and computers. Annual bilateral cooperation agreements between the two form the framework for the Ministry' endeavours in the field.

An agency responsible to INSAC, the Instituto Central de Investigaciones Digitales (ICID) was set up to implement research projects on schemes for the national production of hardware and it was as a result of this that Cuba developed its CID computer of which there are currently three versions: the 201A, 201B and 300/10. The manufacture of the CID 1408 and 1409 microcomputers, monitors, interfaces and auxiliary rlectronic equipment has also been launched. The main difficulty in the way of the growth of national computer resources is the lack of electronic components which have to be purchased abroad. From this standpoint, the problem of relations with the United States is a major factor.

PRIMARY AND SECONDARY EDUCATION

Teaching of informatics

In some schools - but these are only isolated cases - the rudiments of computing (mainly languages) are included in the curricula.

The introduction of informatics is a slow process, the country being poorly supplied with computer hardware and there being no trained teaching staff.

It is hoped to develop computer science in second cycle secondary so that students are ready to operate computers when they move up into higher education (use of databases, research, etc.).

Computer assisted instruction

This is in its infancy in Cuba (very few cases of its use and no evaluation results) and only in secondary education.

TECHNICAL EDUCATION AND VOCATIONAL TRAINING

There are three technical schools and eight vocational training centres, the former producing 110 and the latter 150 trained technicians (programmers, maintenance engineers and computer operators) each year. Two of the three technical schools have computer rooms and have received the necessary trained teaching staff. It is hoped to intensify the training of technicians and skilled workers in the near future.

Software

Except for some very few cases no educational software has been designed.

Teachers

Teachers are given training in informatics in initial teacher training and in refresher courses for practising teachers but the proportion so trained is very low: one per cent in initial training and 3.5 per cent in further training.

The intention is to step up teacher training in the following ways: systematic inclusion of computer science in initial training courses, upgrading courses for all practising teachers and the provision of intensive short courses.

RESEARCH

At the moment no research is being done on the educational uses of computers but in 1985 the education authorities have a largescale research project drawing on the experience of Quebec province, Hungary and Bulgaria. The objective is to have microcomputers present at all levels, the content of curricula being designed as a continuous sequence from primary to the end of secondary. To this end, it is planned to bring in a system for the training of teachers using the mass media, to encourage the formation of microcomputer clubs and the holding of competitions, etc.

MANAGEMENT APPLICATIONS

These relate almost exclusively to administrative management and planning. The computer has not yet penetrated the educational management area where computerisation is not expected to develop in the medium term.

The computerised administrative management functions are the administration of staff, records of technical staff and of heads of higher teacher training institutes, a directory of these institutes, etc.

The planning functions relate to the planning of teaching staff at all levels of the educational system, the running of the computer rooms and "laboratories", textbook production and distribution, annual statistics, school construction records and research.

The Ministry of Education uses both its own facilities and those of other bodies on a shared-time basis.

Administrative management functions are decentralised but planning functions are only partly so. Decentralisation has been made possible by the installation of computer hardware in higher education and vocational training establishments and the use that government area offices make of the provincial computer centres which are open to all.

The phased installation of microcomputers has begun at the Ministry of Education where they will eventually be in general use.

A variety of software is used in management applications, including the MARS program.

The difficulties currently inhibiting management computerisation are of several kinds: inadequate finance for the purchase of hardware particularly that having to be imported from the United States, the lack of qualified manpower, insufficiencies in maintenance, etc.

The Ministry currently employs 43 computer workers.

Source:

- Desarrollo de la Informática en los sistemas de educacion de paises de America Latina y el Caribe. OREALC/Estadisticas/36. Vol I, March 1985.

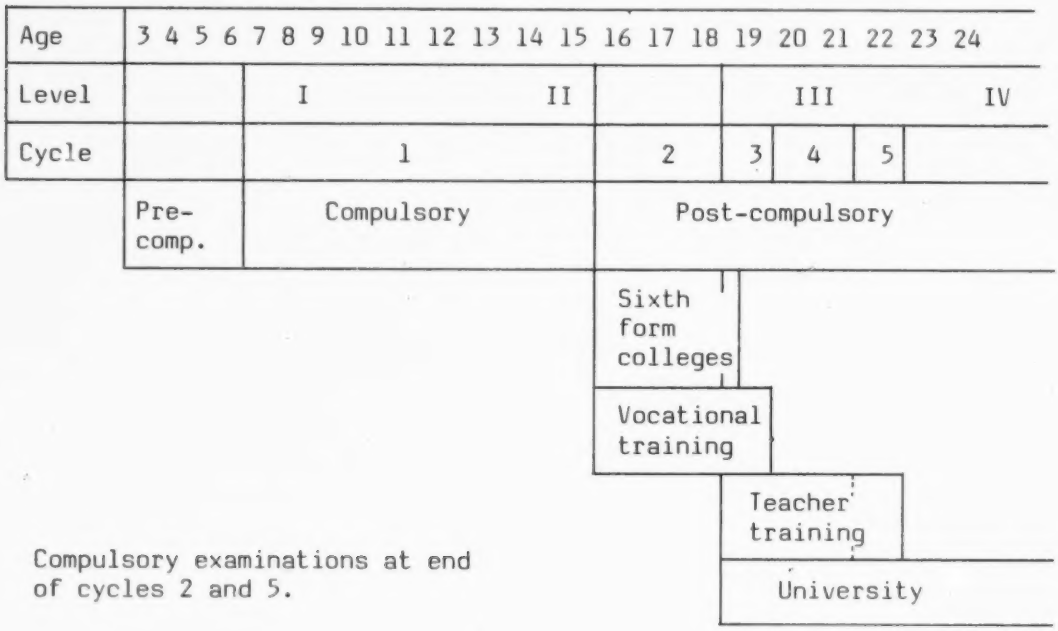
D E N M A R K

Basic data

Total school population: 1 025 300 approx. (1982)

Education budget: 25 020 million Kroner (1980)
as percentage of GNP: 6.9%

Structure of educational system:



Compulsory examinations at end of cycles 2 and 5.

	School population per level	Number of teachers per level
Primary	420 064 (1982)	58 012 (1975)
Secondary	498 462 (1981)	
Tertiary	106 669 (1981)	

Key dates in the introduction of computers in the educational system

1970 Minister of Education sets up a Committee on the teaching of informatics.

1972 A report is delivered recommending that informatics be introduced at all stages of education and training.

The Social Democratic Government proposes the subject be optional in lower secondary education (Grades 8-10).

1973 The Government changes.

1975 The new School Act for primary and lower secondary does not even mention informatics. It puts a halt to the experiments which had been steadily growing in the 1970-75 period.

1980 The Ministry of Education issues a new circular for upper secondary which stops the experimental teaching of informatics as an independent subject and urges that instruction, while remaining experimental, should start integrating informatics in science subjects (Jensen, 1982). Six schools start experimentation along the new guidelines.

1982 Informatics is experimentally introduced in two local authorities as a compulsory subject in Grades 5-7 and as an option in Grades 8-9. A new detailed curriculum for the new integrated computer science in upper secondary is issued by the Ministry of Education.

1983 Roughly a third of upper secondary schools apply for integrated computer science. Due to financial reasons only 22 actually start. Informatics is experimentally introduced in second chance education.

1984 A curriculum stating that integrated computer science be a compulsory part of upper secondary education is being prepared. The School Act for primary and lower secondary is changed so that informatics becomes an option in Grades 8-10 and a compulsory part of the curriculum, the local authorities to decide whether integrated in existing subjects or taught as a separate subject.

After a decade of first development then decline of scattered experimentation in the field of informatics in education, Danish education is slowly evolving towards a more coherent approach to policy and development.

At present, while controlled experimentation has started again in a number of schools, there is still no national development plan to introduce the new information technologies in education. However, Mr. Bertel Haarder, Minister of Education in the Schlüter government, has appointed a committee to assist in the establishment of new priorities for the teaching of informatics. A separate committee will advise the Minister on the introduction of informatics in technical education.

COMPULSORY EDUCATION (age 7-15)

Hardware

About 5 per cent of schools had microcomputer equipment in 1981. The figure is expected to be over 15 per cent by 1984. Funds come from the municipalities without subsidies from the state.

Types of application

Computer assisted instruction

CAI programs are used in disciplines such as physics, geography and biology (simulation of experiments) for which software has been produced. In home economics, students are asked to produce databanks for nutritional values of food items and dishes. Computers as a teaching aid were introduced first in special education for remedial courses in the basic skills.

Computer appreciation

The social consequences of more widespread use of computers are treated in the social science course which is compulsory in grades 8, 9 and 10.

Teaching of informatics

Experiments in "datalaere" as an independent discipline were carried out in 1982/83 and 1983/4 in Grades 5 and 6. In the municipality of Odense, the most advanced in the introduction of the new information technologies in education, informatics is offered as an optional subject in Grades 8 to 10.

Software

Production

Most of the software used in Danish schools has been produced by teachers, only a minor part being provided by commercial suppliers.

Additionally, the Dental College for Education and Training, together with the Jutland Telephone Company has developed a special system, the "Datamaskinformidlet undervisningssystem", which is now expected to allow teachers with no knowledge of computer programming to write their own software.

Transferability

The de facto adoption of a common computer language, Comal 80, originally written as an extension of Basic by a group of students, ensures transferability.

SECONDARY EDUCATION

Hardware

About 99 per cent of general secondary schools had computer equipment by 1983, averaging six terminals per school. All vocational schools have computers.

Teaching of informatics

A core of 20-80 hours of instruction is compulsory for all students in vocational technical schools while an additional package of 60-80 hours is optional or compulsory depending on the specific vocational area. A core of 100-200 hours of instruction is compulsory for all students in commercial schools.

Source:

- Document CERI/NT/84.02, OECD.

D O M I N I C A N R E P U B L I C

Basic data

Total school population: 1 500 000 approx.

Education budget: 160 111 000 Pesos (1982)
as percentage of GNP: 2.1%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Level	I II III IV
Cycle	1 2 3 4
	Pre-comp. / Compulsory / Post-compulsory

Basic cyc. | modified cycle

Prim. teach. train.

Second. teacher training University

Compulsory examinations at end of cycles 1 to 4.

	School population per level	Number of teachers per level
Primary	1 092 838 (1982)	23 578 (1982)
Secondary	375 377 (1981)	
Tertiary	28 628 (1975)	

Informatics policies

There is no national policy for the development of informatics, no government body responsible for formulating one and no domestic production of computer hardware.

Applications

No content relating to computers has been introduced into curricula whether at primary or at secondary level, including technical education.

Computers are sometimes used in higher education courses but no precise information is available on this subject.

Management applications

Accounts and budgeting have been computerised at the State Secretariat for Culture, Fine Arts and Education as has the administration of contracts, public servants pay and the administrative and teaching staff rolls. It is intended to computerise the management of national examinations by 1988.

With regard to planning, computers are used for processing statistics and for calculating the efficiency of the school system. The State Secretariat has a computer centre for this purpose but also has hardware on lease and uses sub-contractors in the private sector.

The data processing staff is currently 12 in number and that figure should rise to 22 by 1988.

Source:

- Desarrollo de la informatica en los sistemas de educación de paises de America Latina y el Caribe. OREALC/Estadisticas/36. Vol. I.

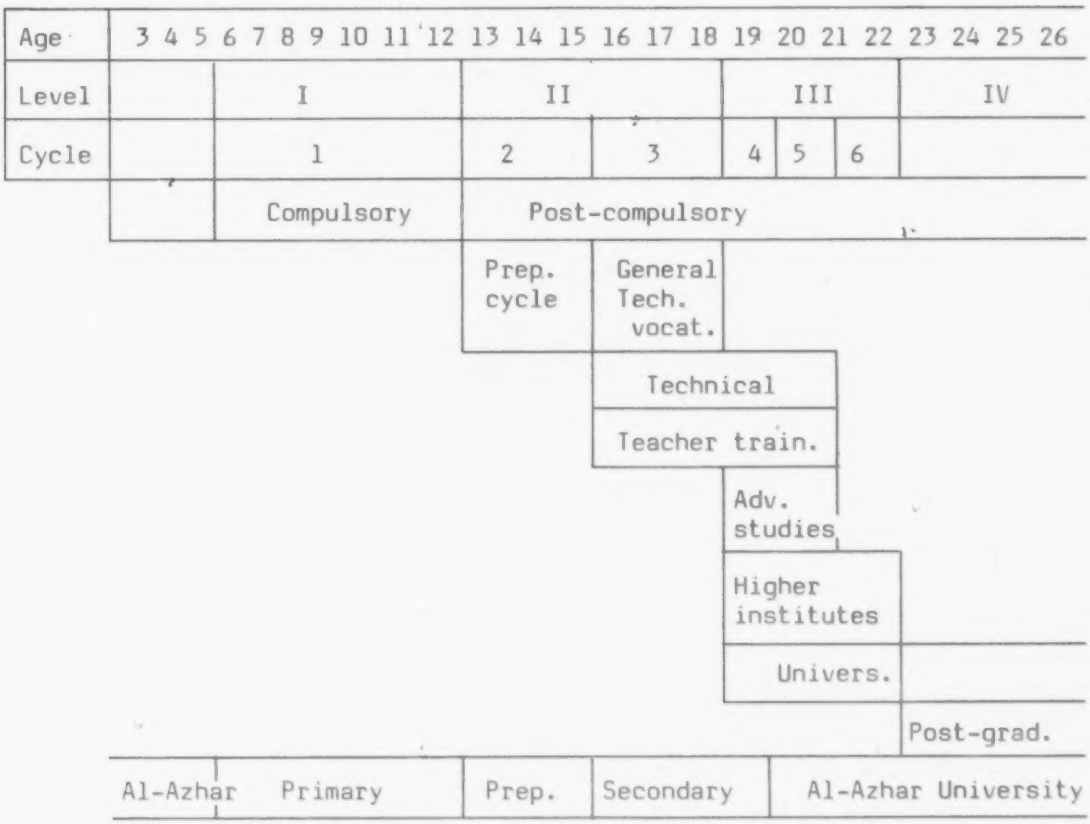
E G Y P T

Basic data

Total school population: 8 234 900 (1981)

Education budget: 918 679 000 pounds (1981)
as percentage of GNP: 4.5%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	4 748 414 (1981)	141 562 (1981)
Secondary	2 919 364 (")	120 948 (")
Tertiary	567 128 (")	25 503 (")

APPLICATIONS

Research

In 1984, the Central Agency for Population Mobilisation and Statistics (CAPMAS) launched three research projects for the development of microcomputers in three universities: Cairo University, Ain Shams and the University of Alexandria.

Source:

- Introduction of informatics in the educational system of the Arab world. Unesco, Nov. 1985.

E L S A L V A D O R

Basic data

Total school population:	800 052
Education budget:	331 445 000 colons
as percentage of GNP:	3.8%
Structure of educational system	Not available

	School population per level	Number of teachers per level
Primary	709 567 (1981)	17 441 (1981)
Secondary	64 702 (")	3 080 (1980)
Tertiary	25 783 (")	1 220 (1981)

Informatics policy

There is no national policy for the development of informatics in El Salvador. No central government body has any specific mandate in this field and there is no domestic production of computer hardware.

This situation is the result of the lack of information about available equipment and its uses, the absence of qualified maintenance services and the dependence on imported software (and the lack of Spanish language software in particular).

Applications

The following table summarises the use made of computer facilities at the various levels of education.

Distribution of the use of computer facilities in education

Level	Type of establishment	Used for administration				Used for teaching			
		M	S	F	N	M	S	F	N
Pre-basic	Public				X				X
	Private			X					X
Basic	Public				X				X
	Private				X				X
Secondary	Public			X					X
	Private		X				X		
Higher	Public			X				X	
	Private		X				X		
Training and adult Education	Public				X				X
	Private				X				X

M = in many cases - over 50%
S = in some cases - 10-50%
F = in few cases - under 10%
N = in none.

As can be seen there are no applications at all at the pre-primary, primary and adult education levels. There are some cases of computer use in secondary education but they are mainly in the private education sector (teaching of informatics) which means that disadvantaged children are excluded. No applications are referred to for secondary technical education and vocational training.

Software

There is no domestic production of educational hardware.

Teachers

No computer instruction is given in initial teacher training but training programmes have been instituted for practising teachers as have seminars and occasional short courses. About one per cent of teachers have been covered by the training programmes and about two per cent by the short courses.

Management applications

In the Ministry of Education, it is the Directorate for Informatics and Educational Infrastructures - DIIE - (which comes under the Office of the Plan and Organisation) that has the computer room and is reponsible for management applications, practically all of which relate to administrative functions. The very few educational manmagement applications there are concern the administration of examinations and the planning applications relate to statistics and censuses.

As regards the administrative applications, accounts and budgeting are computerised, as are purchasing, stock control and public officials' pay.

The maintenance of coherent information systems is made difficult by the country's political situation and by the efforts to decentralise the administrative services (some of which have microcomputers): information flows are disrupted and data are not homogeneous. One of the prime concerns, therefore was to make the administrative services' equipment compatible. Alongside the process of equipping them with microcomputers, standards are soon to be defined for data collection and processing. However, the computerisation of the management of the educational system is inhibited by the lack of resources for the purchase of hardware and the absence of competence for the choice of which to buy, excessive bureaucracy, foreign exchange difficulties, the inefficiency of the maintenance services and the lack of qualified staff often attracted by the higher pay in the private sector.

At the moment, the Ministry of Education employs 12 specialists; the figure should rise to 22 by 1988

Source:

- Desarrollo de la informática en los sistemas de educación de paises de America Latina y el Caribe. OREALC/Estadisticas/36. Vol I.

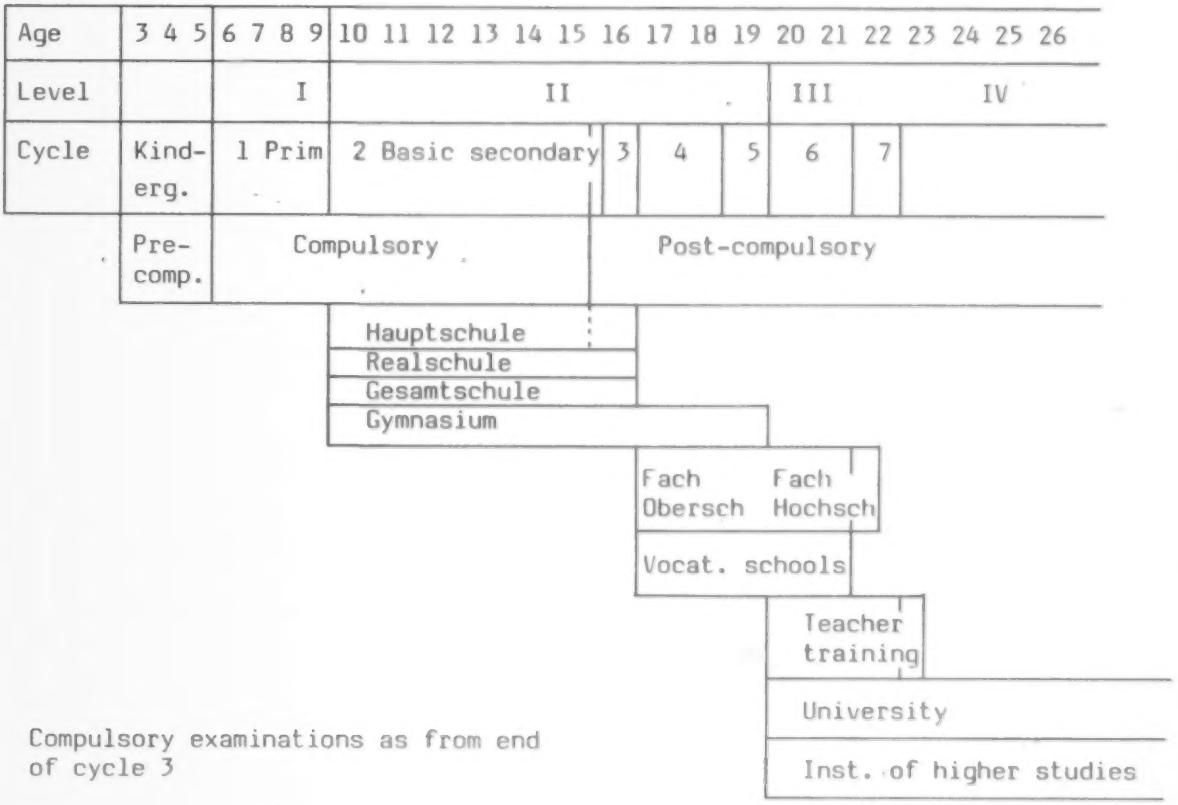
F E D E R A L R E P U B L I C O F G E R M A N Y

Basic data

Total school population: 10 260 000 approx. (1982)

Education budget: 70 098 600 000 Deutschmarks (1980)
as percentage of GNP: 4.7%

Structure of educational system:



Compulsory examinations as from end of cycle 3

	School population per level	Number of teachers per level
Primary	4 600 000 (1982)	267 417 (1982)
Secondary	4 254 000 (")	307 179 (")
Tertiary	1 405 478 (")	177 146 (")

Background information

At the begining of the 1970s the Länder of the Federal Republic of Germany began introducing computer science in secondary level teaching.

Since 1971 the Federal Ministry of Education and Science and the Länder governments have together provided support amounting to over DM 52 million for 54 pilot projects, the Federal Government and the Länder contributing 50 per cent each. For the period 1984-86 the Ministry will provide another DM 3.44 million for current pilot projects in computer science and the Länder will again match that figure.

These pilot projects and in particular the uniform examination requirements for the Abitur in all the Länder have had a strong and beneficial influence on the organisation of computer teaching.

All the same, the forms and opportunities of computer science teaching vary considerably from one Land to another. This is due, for one thing, to school organisation but above all to Land-specific prerequisites for teacher training and the equipment of schools.

Together with its report on "Information Technology", the Federal Government will shortly be submitting draft legislation to the German Bundestag presenting a general strategy for promoting the development of micro-electronics as well as information and communication technologies.

In the Federal Government's view, this strategy needs to include the integration of technological innovations in the education system as regards both curriculum content and teaching methods.

After the introduction of computer science as a subject in secondary level II by all the Länder of the Republic, particularly in grammar schools, the central issue now is how to ensure a broad-based education in computer science for all pupils of secondary level I.

Some of the Länder have already carried out far-reaching practical measures or largely drawn up their own plans.

Within the framework of the promotion of pilot projects by the Bund-Länder Commission for Educational Planning and Research Promotion (BLK), this issue will be given attention by establishing a new priority area for pilot projects.

The Federal and Länder governments agree that the new information technologies form a subject in its own right and at the same time are a tool for improving and clarifying teaching methods in other subjects.

The contents of teaching to be developed are as follows:

- Provision of basic skills for tackling problems by using information technologies and handling of pertinent devices (computer literacy).

- Acquisition of knowledge of the practical applications of the new technologies in the everyday environment as well as in working life.

- Formation of an independent opinion on the possibilities and limits of these technologies.

SECONDARY EDUCATION, SECOND CYCLE

Computers in use

In two Länder all second cycle secondary schools have computers. In the others, the percentage ranges from 30 to 80%.

Only a few of the first cycle (compulsory) secondary schools have computers.

Financing

Hardware is generally funded by the authorities responsible for school finance in other words the local authorities or, in the case of private schools, the bodies they belong to.

Types of application

Computer assisted instruction

CAI is primarily used in subjects like mathematics, computer science and the natural and economic sciences.

Computer appreciation

Thoughts on the advantages and dangers to society of computerisation are given in lessons on the social sciences and related subjects. For this particular subject there are very few co-ordinated curricula or specialist teachers.

Teaching of informatics

In all Länder (in Schlesvig-Holstein only experimentally), computer science is offered at secondary level grammar school as a basic course and - in the Saar - also as a special achievement course. In most of the Länder, computer science can be taken as a third or fourth Abitur examination subject.

Computer science can also be offered as an optional subject (in which case the teaching may be organised in working groups). In some Länder computer science classes are offered for grades 9 and 10 of intermediate schools and grammar schools (lower secondary education) either as an optional subject or included in other subjects.

Computer science curricula cover the construction of algorithms for problem- solving and computer know-how and applications. At present, computer science classes are attended by about 10-15% of all students in the relevant age groups.

Software

Production

Most of the courseware has been written by teachers but some has been developed under the pilot projects. A number of scientific institutions have also developed courseware mainly for natural science. Very little software is available commercially there being no private sector production.

Quality control and evaluation

The public institutions responsible for the distribution of courseware in the Länder (see below) are also responsible for monitoring its quality. Quality control of courseware issued is also performed to a lesser extent by the scientific institutions and teachers' and lecturers' associations.

Distribution

In some Länder there are public institutions which compile and document courseware and make it available to schools and also advise schools on software production. There are also private institutions which teachers, university lecturers and others have formed by association in order to centralise, document and exchange courseware.

Teacher training

In some Länder students learning to be grammar school teachers can acquire the qualification for teaching computer science, generally by passing an additional examination. In other Länder the mathematics examination for student teachers may include computer science.

In all Länder, teacher training in computer science is now, and will continue to be so for some time, largely a matter of in-service and further training.

VOCATIONAL TRAINING

Early in 1980, the Federal Ministries for Economic Affairs and Education and Science instructed the Federal Institute for Vocational Training to take developments in microelectronics into account in its work on the re-classification of occupations requiring formal training. A major problem here is which aspects of microelectronics should be taught in vocational training. The work is being done with the help of industrial experts whose involvement ensures that foreseeable technological progress in the industries concerned is allowed for in initial vocational training. The same applies to the Standing Conference of Länder Ministers of Education and their formulation of outline curricula for vocational schools, the object being to harmonize these with training directives.

The new classification of commercial occupations, now almost complete, has been greatly influenced by progress in the information technologies. For a total of 12 commercial occupations requiring formal training, between 1977 and 1981, a single standard for the theoretical and practical teaching of data processing was included both in the training directives and in the outline curricula for vocational schools. In the courses for these occupations, data processing is a subject in the final examination and includes "organisation" and "accounting".

So far, the number of pilot experiments in the field of information technology and vocational education is small. In January 1984, the Federal Ministry of Education and Science launched a number of pilot experiments on "New technologies in vocational education". The DM20-25 million earmarked for this purpose will enable 20-25 projects to be funded in business firms. Associations of firms will also be possible and the joint use of training facilities. Experimental activites at vocational training schools will be subsidised by the joint educational planning and research commission as part of its activity in support of pilot projects. The results of the pilot projects will be used to develop generally applicable arrangements enabling young people to gain the knowledge they will need to be able to cope with the new information technologies in their working life.

Source:

- Document CERI/NT/84.02 (OECD)

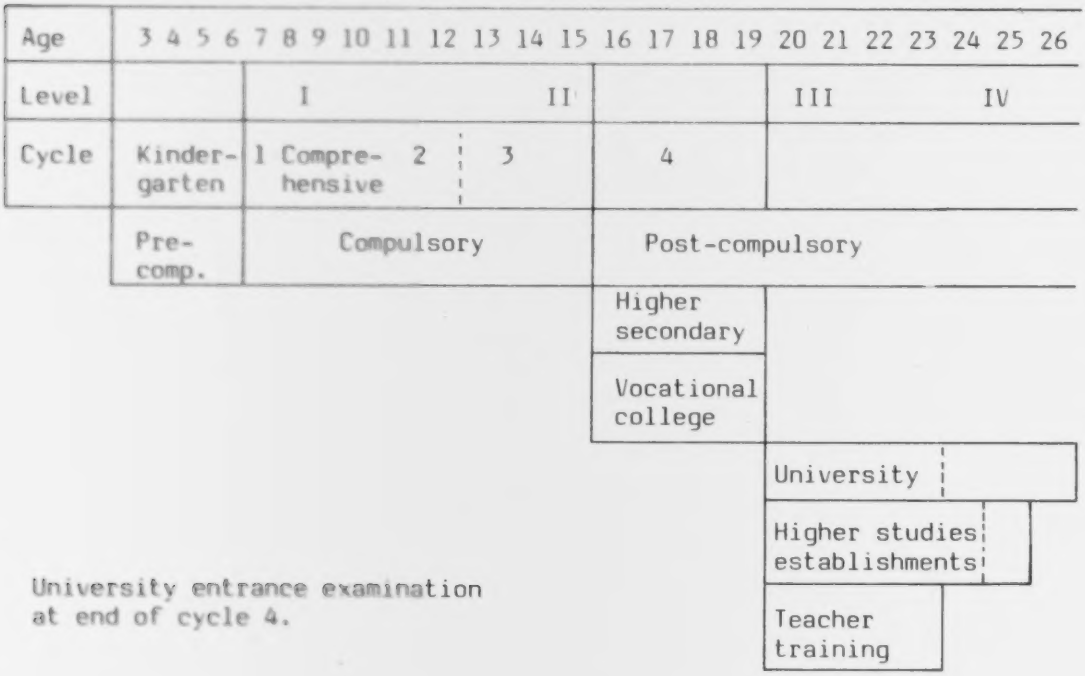
F I N L A N D

Basic data

Total school population: 926 400 approx. (1982)

Education budget: 12 053 168 000 Markka (1981)
as percentage of GNP: 5.8%

Structure of educational system:



University entrance examination at end of cycle 4.

	School population per level	Number of teachers per level
Primary	365 965 (1982)	24 752
Secondary	432 761	37 098
Tertiary	127 657	

Key dates in the introduction of informatics in the educational system

1970 Instruction in data processing started in technical and commercial education institutions (first as voluntary courses).

1980 Project related to computer science in the upper secondary school set up to examine the need for computer-assisted instruction in various subjects. A curriculum for computer science is prepared. The use of computers in educational administration is also examined.

1981 Working group appointed to examine the acquisition of computer equipment and programmes in upper secondary schools.

Information technology project started with the aim of including basic instruction in information technology in all vocational education by 1987.

1982 Course in computer science included in the upper secondary school curriculum.

1983 Case study completed on the production of computer programs adapted to educational purposes and procedure for the approval of programs for school use approved.

Present situation

The introduction of the new information technologies in the Finnish educational system is a very recent phenomenon. In the past only the vocational education sector had been involved and at that only to a modest extent. The current policy is to start at upper secondary level and with the vocational sector (itself undergoing major reform). A short term forecast would see the successful implementation of equipment policies and the persistence of severe problems in software production.

There are no current or foreseeable plans for the comprehensive schools and computer-based experiments are run only in special schools.

PRIMARY EDUCATION

Virtually nothing exists at this level with the exception of experiments in special schools. A collection of software has been produced within the DIDATA system (the "talking computer") at the university of Jyväskylä under the supervision of the Bureau for Special Education of the National Board of General Education and also by private teachers groups. At present there are 180 such programs for primary education.

LOWER SECONDARY EDUCATION

Types of application

Computer appreciation

Courses were brought in with the revision of the comprehensive school curriculum in 1983, mostly as an integral part of the social science curriculum and the (optional) commercial subjects.

Teaching of informatics

The basics of computer science are integrated in the mathematics curriculum in Grade 9. In future they will also appear in technical classes. Usually this teaching is given without any computer equipmenmt.

Informal education

For several years now, the comprehensive schools have run "club" activities related to informatics and electronics. The clubs have been able to borrow equipment from the upper secondary classes which often share the same premises. The activities mainly concern programming and the building of electronic equipment.

Computer assisted instruction

This is only used for remedial courses in special education.

UPPER SECONDARY EDUCATION

Hardware

Computer equipment was introduced en masse in 1981. 40 per cent of schools were equipped the first year and 30 per cent more by the second year of operation. The finance was provided by the municipalities with state aid, conditional on the purchasing of hardware and software recommended by the National Board of Education.

Software

Production

A severe shortage of software exists. Some has been produced by teachers and commercial suppliers.

Financing

State aid is granted for the acquisition of the software on the National Board of Education's "good quality" list (see below).

Diffusion

Since the spring of 1983 the National Board of Education has been vetting programs and listing those suitable for educational use.

Teachers

Courses for teachers have been organised jointly by the association of mathematics teachers and the National Board of General Education.

VOCATIONAL TRAINING

The vocational education system is to be reformed over the period 1982-88. One of the aims is to introduce basic training in data processing in all basic branches by 1987. The estimated expenditure on the acquisition of hardware is about 13 to 14 million Markka per year, of which over 11 million will be state aid.

Hardware

All technical and commercial institutions have compuiter equipment. For other establishments the situation is far from the stated objectives of the reform.

Teaching of informatics in the curriculum

Starting in 1982-83, 15 institutions other than the technical and commercial establishments are to try out the basic course in informatics. The trial ends in 1985-86.

Teacher training

In-service training on computers is available in technical and vocational schools and is in practice compulsory for all teachers. A development plan for both initial and in-service training is being formulated by the project group on information technology appointed by the National Board of Vocational Education.

Source: - Document CERI/NT/84.02 (OECD)

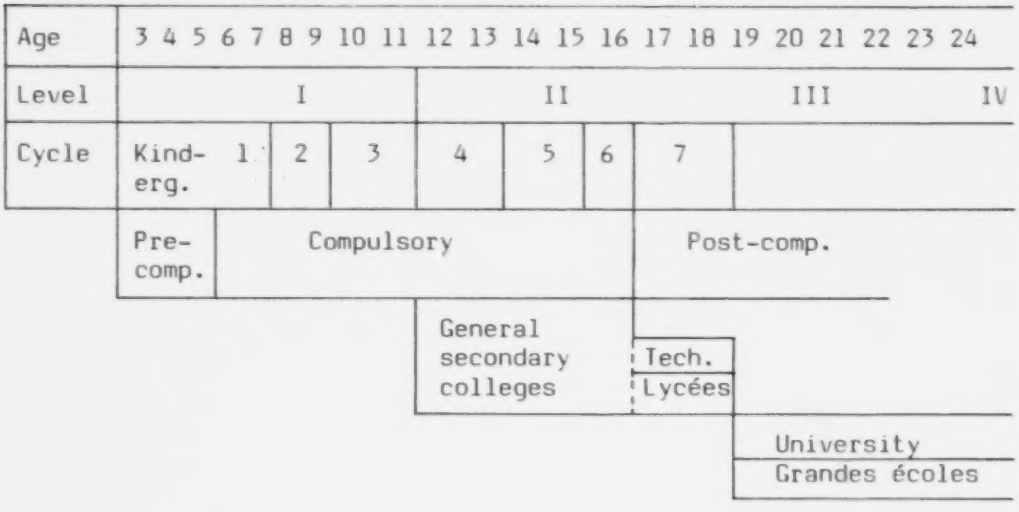
F R A N C E

Basic data

Total school population: 9 500 000 approx.

Education budget: 141 711 million Francs (1980)
as percentage of GNP: 5.1%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	3 914 450 (1982)	235 535 (1981)
Secondary	4 458 456 (")	288 621 (")
Tertiary	927 230 (")	

Number of computers in use in education: 160 000 microcomputers, 80 per cent in secondary schools.

Number of home computers in use: About 800 000

Key dates in the introduction of informatics in the educational system

1970 An international conference organised by the OECD launches the French debate on the introduction of computers in education.

1970 The "Mission à l'informatique" is set up in the Ministry of Education. The declared objective is to make visible the potential impact of the new field of knowledge on all school subjects.

1972 To that end, the "opération 58 lycées" is launched by the Ministry of Education equipping 58 schools with miinicomputers, training teachers and having the teaching body produce courseware in all disciplines.

1976 With the first microcomputers coming on the market, the "58 lycées" operation and the training of teachers is broken off. The evaluation of the operation begins (which went on to 1981).

1978 The French Government decides to relaunch informatics.

1980 A 6-year plan is launched jointly by the Ministry of National Education and the Ministry of Industry. The is the "10,000 micros" operation which aims at equipping second-cycle secondary schools with 10,000 microcomputers. Gradually the Ministry of National Education becomes solely responsible. The plan has a dual purpose: to develop the use of computers as a teaching aid in all disciplines and to familiarise all schoolchildren with informatics.

1981 When the new government comes to power, the Ministry of National Education freezes the 10,000 micros operation on the grounds that it takes insufficient account of the educational objectives, consultation with the various partners and the coherence of the various parts of the plan. Two university scientists are asked for a report and this lays down the guidelines for a new plan of action: priority to go to training, decentralisation, the essential nature of research, assistance for young people having difficulty in school, a greater call on higher education and profiting from earlier experience.

1982 A project is launched for developing a new author language, Diane, whose purpose is to allow software to be designed without any special knowledge of programming.

1983 Before completion of the "10,000 micros" operation, a new and more ambitious project is launched aimed at achieving, by 1988, the figure of 100,000 microcomputers in use in schools, the necessary staff of computer specialist teachers and an equivalent level of courseware production.

1985 The "Informatics for all" scheme comes out. In January 1985, the Prime Minister announces the institution of a plan for that year consisting of an extension of the 100,000 micros operation. The project has a three-part objective:
- to initiate all schoolchildren at all levels in computers as a learning aid. By June 1986, every student, at the end of the last cycle in a lycée or vocational training lycée or the first cycle at university, will have worked at least 30 hours on a computer.
- to open computer rooms to all French people under an agreement contracted with the local communities or associations.
- to train teachers: over 150,000 teachers will have had an introduction to a computer language by December 1985.

The plan is to install 120,000 microcomputers in schools during the 1985-1986 school year. One out of every five primary schools (i.e. about 8,000) and a large proportion of the 7 000 lycées and colleges are to be equipped in this way.

The cost of the "Informatics for all" plan is put at 2 billion francs.

Teacher training is the responsibility of the Ministry of National Education which will have a supplementary budget of 400 million francs.

The hardware (and software), estimated cost 1.6 billion francs, will be financed by the PTT Ministry (up to the level of 1.2 billion francs which will be made available to the Ministry of National Education) and the Industrial Modernisation Fund (400 million francs).

The PTT Ministry is involved as being responsible for the "electronics side".

The Industrial Modernisation Fund, for its part, whose primary role is to fund firms' purchase of production automation systems, will pay 400 million francs into the Small and Medium Firms Equipment Fund which will enable schools to obtain their computers on hire-purchase.

The fitting out of educational establishments with computers will be backed up by an unprecedented campaign to train trainers before the end of 1985. In addition to teachers that have already had an introduction to or training in computers as part of the 10,000 and then 100,000 micros schemes, the plan is to train 106,500 teachers in intensive 50-hour courses. 800 courses of 300 hours each are planned for higher education.

Thus at the end of 1985, nearly a quarter of French teachers will have had an introduction to informatics and every computer room will be staffed by at least 10 trained teachers.

Additional information

In spite of government efforts to support it (by public procurement policy in particular), the French computer industry has a very low ranking internationally (under 2% of the world market) and nationally as well (the 10 French manufacturers control about 25% of the domestic market). All French firms in the microcomputer sector are working at a loss.

Also, the protectionist public procurement policy (all government departments have to buy French and this applies to the hardware bought for all levels of educational establishment) has not been fully successful to the extent that "spontaneous" buying (out of teachers' or establishments' own budgets) inclines towards foreign machines marketed at far lower prices than French hardware.

It is estimated that, for every child at school (from kindergarten to the end of the second cycle) to have the use of a terminal for one hour daily (one terminal for eight pupils), the target in the "10,000 micros" operation, 1,500,000 computers would have to be installed in school establishments.

Opposition to the penetration of computers at school is of many kinds. Hence the efforts, mainly at the instigation of the World Informatics Centre (CMI), to launch experiments in computer appreciation and microcomputer training alongside what is done in the national education system: training of young unemployed, holiday centres with training in computers, pilot operations in certain districts, etc. (cf. informal education).

Bodies involved at the national level

National Centre for Educational Documentation (Centre National De Documentation Pédagogique - CNDP) under the Education Ministry.

Informatics Agency (Agence de l'Informatique - ADI) under the Ministries of Industry and Research.

Research Centre on Advanced Systems and Technologies (Centre d'Etudes des Systèmes et Technologies Avancés - CESTA) under the Ministry of Research.

World Informatics Centre (Centre Mondial Informatique - CMI) under the Ministry for the Plan and Regional Development.

PROJECT POLICY

The Ministry of Education's policy in the informatics field is organised around three objectives:

- To give informatics its place in general education: the "informatics dimension" should be developed in the teaching of primary school subjects and become a part of the technical culture to be acquired in college and of basic scientific training in the lycée and the university.

- To use computer resources to improve the effectiveness of teaching particularly for the benefit of pupils in difficulty at school (as an aid in remedial classes to acquire basic knowledge and for the development of analytical and organisational capacities).

- To train computer workers and specialists in all branches of the electronics industry for which there is a national plan. Responsibility for a plan to accompany the development of the electronic sector has been placed on the Ministry for National Education to cover initial training, alternate courses and adult education.

  More generally, the Ministry of Education's policy dovetails into an industrial policy aimed at developing the French hardware and software industry.

PRIMARY EDUCATION

Hardware

It is impossible to give an accurate figure for the total number of units installed in primary schools because of the variety of agencies providing the finance*. The funding may be met "spontaneously" (computers bought by teachers with their own money), locally (local authorities) or under a contract

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* One estimate puts the number in 1985 at 40,000 machines.

between the Ministry of Education and the Département authorities. In 1983-84 a number of contracts of this kind resulted in the installation of over 2,00 Thomson TO-7 microcomputers (produced in France) in the primary schools of 16 départements. Overall, these contracts cover the installation of 6,000 microcomputers in primary schools, colleges and vocational training lycées over the period 1983-85.

These contracts, in which the two parties go halves, apply to areas affected by economic difficulties, educational backwardness or their isolated situation. The microcomputers concerned are consumer market machines and always of French manufacture.

In the framework of the "Informatics for all" plan, 33,000 primary schools are to receive a home microcomputer together with a screen, cassette reader and printer. 24,000 of the computers are the Thomson TO-7-70 and 9,000 are the Exelvision (subsidiary of CGCT) 9000 EXL100. In addition, 9,140 schools or groups of schools of 400-500 pupils are being equipped with a nanonetwork made up of one professional IBM PC compatible microcomputer and six Thomson MO5 home microcomputers.

Types of application

The computer-based activities for children in primary school come under the heading of "pédagogie d'éveil" (awakening to computers and technology). The variety of applications under that heading is very great. Another application is the experimental use of Logo (see also pilot experiments).

Software

Software used prior to 1985 was produced, evaluated and distributed in the common framework of the CNDP (National Educational Documentation Centre). As a feature of the "Informatics for all" plan, every computer room is supplied with a package of software (average value 20,000 francs). Part of this is supplied automatically with the hardware and the rest can be chosen out of a catalogue by the computer room activity leaders.

Teachers

Prior to 1985, teacher training was given in the primary teacher training colleges by instructors that had taken the comprehensive one-year course in the centres for intensive training in informatics and its educational applications (see details under second-cycle secondary education). For the implementation of the "Informatics for all" plan, teacher training is given by means of an intensive 50-hour course outside school hours.

FIRST CYCLE SECONDARY EDUCATION

Hardware

The computer equipment installed in colleges is of the same kind as that with which lycées were fitted out under the "10,000 micros" operation (see second cycle secondary education).

The configuration adopted is 6-7 computers (mainly MICRAL) per establishment (compared with 8 for lycées). The microcomputers have graphics facilities.

The extension of the equipment to colleges was carried out in collaboration with the ADI.

Under the contracts between the central government and 16 départements (see primary education) the colleges in these départements also received 2,300 TO-7 nano-machines in 1983 at the rate of 6, 8 or 12 per establishment.

On top of the 2,000 colleges already equipped there are 3,153 colleges which are each to receive, under the "Informatics for all" plan, one professional IBM PC compatible microcomputer and 6 Thomson MO5 family microcomputers.

Financing

As in primary education the sources are very varied, different in nature and difficult to evaluate. They are of four kinds:

- For the first 48 installations, co-financing by the Ministry of Education and the Ministry of Industry (ADI for one-fifth of the amount).
- Local authorities at regional and département level.
- Municipalities.
- Teachers' and establishments' own resources.

Types of application

The experimental introduction of computers in colleges began by the overflow of the "58 lycées" experiment. Some 40 colleges were involved between 1970 and 1980.

- Applications, as in primary school, are essentially introductory (learning the rudiments of basic technological culture).
- CAI applications are primarily for schoolchildren in difficulties.
- Computers are also available on a do-it-yourself basis for informal education in computer clubs.

Software

The colleges use the products developed for the operations described above ("58 lycées" and "10,000 micros" - see below) validated and distributed by the CNDP.

The production of specific software is left to the initiative of college teachers.

Software is evaluated by users and the CNDP and validated by the Colleges Directorate at the Ministry of Education.

National distribution is operated by the CNDP after validation of programs.

As part of the "Informatics for all" plan, each college computer room receives one package of software supplied automatically with the hardware. The remainder is chosen from the catalogue by the computer room instructors.

Teachers

Two types of training are available for teachers:

- A twelve-day "user" course (4 3-day sessions) at the teacher's place of work and in working hours.
- A comprehensive course of 750 hours (a full school year) intended for future teacher trainers given by the Centres for Advanced Computer Science Training (see second cycle secondary education).

For the "Informatics for all" plan, teacher training is given in a 15-hour crash course outside school hours.

SECOND CYCLE SECONDARY EDUCATION

The informatics plan for school establishments primarily concerns the lycées (for which the provisions of national policy were defined and implemented) and it is under that heading that their detailed description is given although, since 1982, they have been extended to the whole of the educational system.

Hardware

In 1983 about 1,000 establishments were equipped with a configuration of 4-8 semi-professional micro-computers with a printer and, for the most recent of them, a graphics screen. The computers have a 64K memory and twin 5-inch disc drive.

The planned standard configuration (specified for the "10,000 micros" operation - see below) is 8 microcomputers plus one printer per lycée equipped.

By the end of the "100,000 micros" plan all second cycle establishments should have a standard configuration consisting of semi-professional and consumer market hardware (Thomson, Léanord, Bull, SMT GOUPIL, MATRA, etc.). Under the central government/département contracts, the vocational lycées (LEP) are to be fitted with general market TO-7 nano machines (cf. primary education). The LEP have, in any case, a priority ranking in the government scheme to equip schools with computer hardware, particularly those joining in the government schemes for taking in young people aged 16-18.

In 1982, together with the ADI, the Ministry of Education launched a study on new microcomputer ranges allowing a variety of programming activities.

The "Informatics for all" plan provides that the lycées should be equipped with an enlarged computer room made up of a nano network of 8 Thomson MO5 microcomputers connected to a professional microcomputer plus three IBM PC compatible stand-alone units. 911 establishments are concerned. In addition, 200 lycées already equipped will receive supplementary equipment.

Financing and costs

Finance comes from the Ministry of Education's lycées directorate, local and area authorities and establishments' own funds. With this variety in sources it is impossible to work out the exact total but the standard configuration (8 microcomputers at 20,000 francs each plus one 10,000 franc printer) gives an average cost per establishment of 170,000 francs.

In the "10,000 micros" operation for 1982-83 the cost of equipping the schools came to 38% of the total cost of the operation, i.e.

- hardware: 70 million francs
- training: 90 million francs
- software: 20 million francs

Types of application

- Computer assisted instruction in all subjects.
- Aid to the development of logical thought and analytical and structuring abilities (data acquisition and processing), familiarisation with technological tools.
- Presence of microcomputer clubs in many establishments.
- Teaching of informatics.
- In vocational training courses, computer science is part of industrial and tertiary training (vocational lycées, technical sections in lycées, senior technician sections).

For 1984, the modernisation of computer hardware and the training of staff in the technical training sector financed in collaboration with other ministries and the regional authorities should altogether total 64 million francs for the school section (vocational lycées, technical lycées and senior technician sections).

Software

Because of the shortage of educational products, the Education Ministry launched a programme for the development and production of courseware as part of the "100,000 micros" operation and set up a structure for software production and distribution at the CNDP (National Educational Documentation Centre).

Production

The CNDP then transcribed onto microcomputer the courseware inventoried at the end of the "58 lycées" experiment on all the microcomputers in use in the national education system (making a first library of about 400 pupil/hours diffusable in LSE (Langage Symbolique d'Enseignement, see "58 lycées" experiment) and the transcription was sent to every computer-equipped establishment.

The production plan is to add a further, first, 300 and then 700 hours to the choice of courseware produced by teams of teachers (with the CNDP looking after the technical side and distribution). This national production facility is supplemented by local production at the initiative of teachers and encouraged by the administration.

Also, as part of the "Informatics for all" plan, each lycée computer room will receive a package of software (average cost 20,000 francs per computer room). Part is supplied automatically with the hardware and the remainder is selected from a catalogue by the teachers running the computer rooms. The aim is to be able to offer about 500 programs at the opening of the school year in Autumn 1985, 400 being CAI software and 100 "Informatics for all" programs.

Software writing

Apart from the production of courseware to suit the curricula in different subjects and levels of education efforts are being made to develop, at the same time, systems making it easier to write programs: development of portable and author computer languages (the DIANE project in collaboration with ADI) and applications languages (research on Logo on the basis of the development of French software and hardware).

Private production

Some schoolbook publishers have formed associations with computer manufacturers to produce educational software (Nathan/Thomson, Hachette/Matra, Hatier/Atari).

Cost

All the costs of producing software (for all educational levels) is borne by the national education ministry and ADI (two thirds for the former and one third for the latter).

The total figure is 16 million francs, 11 for the contracts for the design and production of products and 5 for the detachment and replacement of teaching staff working on software development.

Teachers

Training

In-service teacher training is of two kinds:

- Comprehensive training lasting one year full time, with no teaching duties, organised by the universities and grandes écoles in Centres for training in computers and their educational applications (in 25 Education Areas).

  This in-depth training is intended to enable teachers to take their place in teams training teachers who use microcomputers in computer-equipped establishments, developing educational software and giving certain computer courses.

  Priority is given to lycée teachers but staff from colleges, researchers and instructors in the administrative services and the teacher training schools are also admitted.

These training centres will eventually become computer resource centres equipped with experimental and demonstration computers and peripherals.

The 750 hours in the one-year course break down as follows:

- 300 hours on general informatics (analytical and programming methods).
- 300 hours on CAI (typology of applications, contribution of the computer to each discipline, personal courseware project).
- 150 hours instruction in the training of computer-using teachers in computer-equipped establishments.

Between 1981 and 1983, 630 teachers took the comprehensive training course and 500 more took it in 1983-1984.

The teachers that have taken this comprehensive course then train computer-using teachers at the rate of about 20,000 a year bringing within range the critical mass necessary for the complete conversion of the educational system.

The cost of this comprehensive course for years 1981-83 was about 99 million francs, 8% going on the contracts between the ministry and the training centres, 86% on replacing staff in training and 6% on replacing instructors.

- A mini-course is given to computer-using teachers in all subjects in the lycées when they are equipped with microcomputers. The course is given by teachers that have followed the comprehensive course at the school and in working hours and its purpose is to enable teachers to use the courseware. Courses last 12 days split up into 4 3-day sessions.

Between 1981 and 1983, 15,200 teachers were trained in this way and the figure for 1983-84 is a further 20,000.

The cost for the two school years 1981-83 was 38 million francs (remuneration of instructors).

The last feature of the training arrangements is the setting up of a "Mission Académique a la Formation des Personnels de l'Education Nationale" in each "Académie" (educational area) responsible for ensuring consistency in the decentralised and inter-category training measures.

Other training and familiarisation steps are taken in the field - in the educational areas or the schools. These may be experimental or specific: training for teachers in teacher training schools involving a mix of distance education, tuition in the schools and meetings at different times of the year, inter-category summer university to give teachers and administrative staff information on the whole computer field, training courses like those organised by the Mathematical Education Research Institutes (IREM), etc.

Lastly, as a part of the "Informatics for all" plan, lycée teachers are given intensive training in a 50-hour course outside school hours.

The total cost of the training (all the arrangements lumped together) comes to about 90 million francs a year.

THE "58 LYCéES" EXPERIMENT (PRO MEM.)

This experiment, launched by the Ministry of Education in 1972, consisted in equipping 58 Lycées with minicomputers, training teachers and having the teaching staff produce courseware in all subjects.

The experimenmt was dropped in 1976 but the "10 000 micros" campaign then took over.

Objectives

To familiarise secondary schoolchildren with the use of computers.

To familiarise teachers and schoolchildren with the forms of logic specific to computers via the teaching of all subjects.

Overall cost

Over 10 years (1970-1980 and therefore beyond the strictly operational phase of the "58 lycées" experiment) the total cost is estimated at 100 million francs, broken down as follows:

- 50 per cent for training
- 25 per cent for research
- 25 per cent for purchase of hardware.

Hardware

The equipment installed in each school consisted of a minicomputer worked on a shared time basis acting as mainframe computer, a teletypewriter (replaced in 1976 by a disc drive) and eight terminals with keyboard and screen. All hardware was of French manufacture (MITRA 15/CII) and T-1600/TéLémécanique).

The cost of each machine was about 400 000 francs.

Types of application

Computer assisted instruction in all disciplines, mainly in the simulation mode.

Software

Software design was left to the initiative of the teachers. 400 programs were produced in this way during the period of the experiment on the following subjects: history and geography, languages, literature, mathematics, economics, natural sciences, physics, industrial technologies and artistic disciplines.

Up to 1979, the National educational research institute (INRP) provided assistance in the design and distribution of software products and also tested and evaluated what was produced. An "Informatics and Education" section had been set up in 1971 for that purpose, its responsibilities being to lead and coordinate the various research projects and experiments, distribute the software and to make an assessment of the operation.

As of 1981, these functions became the responsibility of the National Educational Documentation Centre which has the task of standardising, monitoring and validating products and producing microcomputer versions for the constitution of a library of software for distribution under the "10 000 micros" experiment. A French conversational programming language (LSE - educational symbolic language) was specially developed for the "58 lycées" experiment. It is of the Algol type and was adopted and kept as the national education system's own language throughout the various phases of the computerisation campaign.

Teachers

Teachers were given two types of training:

- Comprehensive training for volunteer teachers of various subjects, allowed to teach only half-time for one year. The first course was organised on manufacturers' premises (IBM, CII, BULL) but from 1973 to 1976 the training was given in universities in 5 education areas. A total of 500 teachers went on these courses.

- Compact training in the form of a correspondence course run by the National distance teaching centre(CNTE) plus a three-day practical course.

It is believed that some 1000 teachers took an effective part in the "58 Lycées" experiment.

Evaluation

The "Informatics and Education" section of the INRP was made responsible for monitoring and evaluating the experiment. Work on the evaluation began in 1976 and the findings were made known in 1981(1). In other words the "10 000 micros" experiment was launched before the results of the evaluation of the previous experiment were to hand.

(1) See "Dix ans d'informatique dans l'enseignement secondaire", Paris, INRP, 1981.

OPERATION "10 000 MICROS" (PRO MEM.)

This is an extension of the "58 Lycées" experiment and the first phase of the plan for the computerisation of schools. It was launched in 1979/80 with the object of equipping second cycle secondary establishments with 10 000 microcomputers.

Objectives

- To make schoolchildren computer-conscious.

- To develop the use of computers as a teaching aid in all subjects.

Hardware

The target idea behind the "10 000 micros" scheme is to give every student in second cycle secondary the use of a computer for one hour every day, which means providing every establishment with eight microcomputers (complete with screen and keyboard) and one printer.

The French-made computers made obligatory on all the establishments were the Logabax LX 515 and LX 529E, the R2E Micral and Graphique 8022 and the Léanord SIL'Z.

416 machines were installed in 140 establishments during the first year of the project, 800 machines during the second year and 1 600 to 2 000 every year after that, the objective being that all schools should have the standard configuration - 8 microcomputers - by 1985.

1981 saw the extension of the plan, with the collaboration of the ADI, to the colleges (first cycle secondary) and the teacher training institutes (Ecoles Normales) with hardware complete with graphics facilities.

Unit cost per machine was about 21 000 francs.

Types of application

As in the "58 Lycées" experiment, software development was left to the teachers.

As of 1981, the Ministry of Education made the CNDP responsible for monitoring courseware production, which involved:

- Inventorying existing software.
- Planning the production of new software.
- Evaluating and validating products
- Publishing products selected.
- Distributing software.

One of the CNDP's first tasks, in collaboration with the ADI, will thus be to transpose all the educational software produced in the "58 Lycées" experiment onto microcomputer.

At the very beginning the software was developed in Basic Microsoft and later in standard LSE.

Teachers

The objective in the "10 000 micros" projects was to train 50 000 teachers.

- The first year a three-weeks course was offered for 34 instructors (mainly ex-trainees from the comprehensive course). These instructors were then responsible for training teachers in the computer-equipped schools (75 hours of training split up into four three-day sessions (1 500 teachers reached).

- The second year the first four comprehensive training centres were opened (the number increased rapidly during the "100 000 micros" campaign). About a hundred teachers were trained in this way in five months, while 3 000 computer-using teachers took the compact course in their schools.

Future developments

After a momentary freeze in 1981 the "10 000 micros" project was revamped to serve as a basis for the "100 000 micros" scheme launched in 1983 which represented a speeding up of the plan for computers in education and their extension to the whole of the educational system.

EXTRA-MURAL

Marseilles pilot project

The Marseilles research department of the World Centre for Informatics and Human Resources has been running this project since 1982. Defined as a "social experiment in the creation of a computer environment for a whole population", its purpose is to study the conditions in which the computer is adopted as a tool and its social and economic impact in "Belle de Mai" - a popular district in Marseilles.

The theory behind the experiment is that the provision of computer hardware outside the working context may trigger the emergence of new microcomputer uses, contribute to the formulation of new social perceptions of the microcomputer and modify social exchanges in the community concerned. One objective in the experiment (installation of 400 microcomputers for the use of the general public in the district) is to give people a clear understanding of what it is possible and what it is not possible to do with a computer (initiation stage). Another is to offer an alternative to the central models of development of the new information technologies by changing users traditional passive consumer attitudes towards technology: promotion of information production attitudes, self-organisation, institution of local networks, etc.

Sectors where action was taken

- In schools and colleges: development of an active and analytical attitude towards technology and the training of teachers and children in programming.
  Use of Logo.
  Joint development of teaching materials and modules.

- In the vocational training sector (retraining courses or social integration courses for young people in difficulties - socially or in finding employment): lessons to develop awareness of microcomputers as things, the interaction situation between man and machine and the possible uses of microcomputers. This process of familiarisation is based on the use of Logo.

- In the associations and clubs sector: mobile introductory courses, prior to the installation of microcomputers in local clubs and the phased installation of an inter-club computer and communications network.

In general, all the experimental work follows the same three-part sequence:

- Familiarisation/training.
- Permanent installation of hardware.
- Development of long-term cultural projects.

Cost

For 1983, the year when the project moved into its operational phase, its total budget was 16 million francs.
Funds come from the World Centre for Informatics and Human Resources (12 million francs) and the local (Marseilles) authority (4 million).

Television programme

In 1983, one of three public television channels - TF1 - launched a series of educational computer appreciation broadcasts aimed at the general public: two magazine programmes called "Micropuce" (microchip) and "Ordinal 1" ("computerminal" 1) were produced for the purpose by a specialised company owned by the channel.

In 1984 the company put out a new magazine programme (six twenty-minute broadcasts) called "Tiffy, raconte-moi une puce" (Tiffy, tell me a chip) with the collaboration of the CNDP, the ADI and Thomson, the computer manufacturer. Textbooks to be used in conjunction with the broadcasts were distributed via newsagents and will also be issued in cassette form. The channel has also set up a telematics network and is considering distributing exercise courseware by downloading to microcomputer owners.

"Informatics training volunteers" scheme

As a way of helping young people without skills to find jobs and to meet the informatics training requirements of the "electronic sector" plan, the government launched the national "Informatics training volunteers" scheme (Volontaires pour la Formation à l'Informatique - VFI) in 1983. The idea was to have young people out of work given computer training by graduates from the grandes écoles and the universities during their year of national service. The programme is coordinated by the State Secretariat for the Universities and the Ministry for Vocational Training. The World Centre for Informatics and Human Resources is also involved.

In 1983-84, 10 500 young people, age 16-25, were trained in this way by 376 volunteers and in 1984-85 the target is a 60 per cent increase in VFI and the training of 16 000 young workless.

The training falls into two categories:

- "Skilling courses" (qualifying the trainee in computer science or the use of computers) lasting 500 to 1200 hours (training in industrial computer trades or the use of computers in the tertiary sector).

- "Integration courses" (i.e. integration in society or employment) based on CAI, use of Logo, etc. In principle, the object of these courses is to direct young people towards the skilling courses.

The training is given at special training centres for the young unemployed all over France equipped with the hardware needed for the scheme. A survey on the employment of the young people trained in this way is being carried out by a Monitoring and Evaluating Mission set up for the purpose, the results of which are not yet fully known, but it would seem that 56 per cent of those taking the "skilling courses" afterwards found work.

PILOT EXPERIMENT

Logo

Several research teams are working on the Logo project and whereas, in other countries, experiments have related to students' individual activities, in France - although each team does its own research independently of the others, the preference has gone to primary schoolchildren working in groups.

It was at the INRP that Logo was first available (1976). A French version was incorporated in a PDP/10 coupled to a floor tortoise. An abridged version of Logo was then adapted to suit the computers selected for the "10 000 micros" plan. The experiments in schools related to children in the first year of secondary education and children in pre-school kindergartens.

Since 1976 the Programming Institute at Paris 6 University has had a stand-alone configuration (with graphics facility) imported from Quebec (Société Générale Tortue, Ltd.). The research team's work concerns:

- Logo as an educational tool (informatics camp, exhibitions, one-off experiments at various school levels, training of primary teachers).

- Hardware research (prototype music box, series production of floor tortoises).

The Aid to Education Group in the Informatics Department at Paris 8 University takes part in various experiments, gives teacher training and is conducting an experiment in a class where the children have considerable leeway to make up.

Several IREM (Mathematics teaching research institutes) have acquired stand-alone configurations with graphics facility and systems coupled to floor tortoises. They provide teacher training in their areas and conduct experiments in primary and secondary schools.

Dijon University is conducting experiments with first cycle higher education students (comparative study of the process of learning informatics according to language used) and with adults taking further education classes who have had little schooling (diagnosis) and making good shortcomings in elementary logic.

In 1979 these different groups joined forces and formed a common unit (Recherche Coopérative sur Programme), housed at the INRP, which also includes teams from other laboratories (Teacher training schools, National Scientific Research Centre, Educational Economics Research Institute)

The research done by these teams under the project title "Active practice of informatics by the child" is at two levels:

- Educational research of the applied pedagogics type where the aim is to improve teaching and teacher training.

- More fundamental research on psycho-cognitive phenomena and learning behaviours.

The Informatics Agency (ADI) monitors these research projects.

PILOT PROJECT

(Telematics)

Name of project: TELEMEDIATHEQUE

Description

This system, the brainchild of the Bordeaux CRDP (Regional educational documentation centre), connects elementary schools to a resource centre in the département - in this case the Gironde.

Each school has a videotex terminal connected by telephone line or the Transpac telecom network to a host computer accommodating the whole of the system which offers the following services:

- A journal giving educational and cultural news of interest to the schools, the CDDPs (Département educational documentation centres) and various regional and local bodies.
- Administrative information.
- Educational games.
- Programmed lessons or revision by way of support teaching.
- A message switching service enabling the schools to communicate with each other.
- A bibliographical database built up from the resources at the Bordeaux CRDP and the CDDPs in the Gironde (users' selections can be ordered directly via the terminals.

Development

After an experimental phase lasting one year (the 1982-83 school year) when the project was tried out in 10 schools, the plan for the first development phase (1983-85) is to equip 200 schools in the Gironde. All the schools in the département (1029 establishments) should be connected into the system by 1985.

At the time the Télémédiatheque project was being launched in the Gironde a complementsry operation was under way in Biarritz (the Pyrénées Atlantiques département) where the PTT Ministry is also experimenting with an wide band integrated multiple service network (using optical fibre). The object is to use the network for consulting or obtaining the direct delivery of audiovisual documents available in batteries of programmable video discs. The experiment involves all educational establishments at all levels and all the institutions representing the social and cultural life of the city.

The Télémédiatheque project was financed jointly by the General Telecommunications Directorate (PTT Ministry) and the Ministry of Education.

COMPUTERISATION OF ADMINISTRATIVE MANAGEMENT

Background

1964: Creation of a Central Statistics and Current Situation Service at the Ministry of Education.

1965 Creation of a first data processing centre for the management of staff movements. A second centre is set up in 1967 for the analysis of statistical surveys.

1970 As part of the policy of decentralising management tasks to the educational areas ("académies" of which there are 27), launching of a pilot project in two areas.

1971: On the occasion of the VI five-year Plan, development of a master plan for education management hardware; nine data processing centres set up one by one at the education area offices, known as CIATA (Centres Interacadémiques de Traitement de l'Information - Interarea data processing centres). Later the CATI are set up (Centres Académiques de Traitement de l'Information).

1973: Creation of a Management Informatics Under-Directorate at the Ministry of Education responsible for defining and producing management applications.

1978: Development of a master plan for computerised management first applied at area office level and gradually extended to area inspectorates (geographical sub-areas corresponding to the 100 départements) as from 1980.

1979: At the same time the Universities Ministry develops a master plan for computer equipment based on a network of inter-university centres and national host computers.

Present situation

The general adoption of the computer applications developed by the nine CIATI and the phased arrival of specialists and hardware should be effective by 1985.

Experiments on the computerisation of the management of secondary level schools (pupil management files, financial and bookkeeping management) are being conducted with various configurations: stand-alone microcomputers and networked terminals connected to the CIATI.

Objectives of computerised management policy

The master plan for computerised management is a general policy, a medium-term plan with a built-in mechanism for periodical review and whose materialisation depends on budgetary choices.

Its object is to provide users with reliable computer applications which lighten management tasks and produce statistical information.

Coordination arrangements

- Politicy orientations are laid down by a Ministerial Committee for management informatics assisted by a Technical Group reponsible for defining the way in which the scheme should be piloted.

- An Application Committee is set up for each management field which monitors the development of informatics products from specification to evaluation and maintenance.

- Policy deconcentration has led to the creation of regional bodies at the level of the area offices. These Committees of Rectors (Heads of areas) coordinate and programme the work done by the CIATI.

- The "consultant engineer" for the project is the Management Informatics Under-Directorate which is responsible for enforcing the decisions taken by the Ministerial Informatics Commission.

Production of applications

The production centres (CIATI and CATI) are equipped with standard hardware complying with the government restrictions on industrial policy as regards informatics in order to ensure the portability of the applications.

National applications are produced in the CIATI on the reponsibility of project leaders and the application committees for each field.

In order to meet the dual requirements of the national regulations and the local adaptations demanded by users, every application developed has to meet the general technical conditions laid down (configuration and programming language) and has a "parameterable modular" structure enabling it to be adapted to meet the specific requirements set by the location it is to have.

Project leaders have to generate the documentation enabling the applications to be more easily used. They are also responsible for the maintenance of applications (changes necessary because of changes in regulations, requests for improvements, technological progress, etc.). Maintenance of management applications is generally an annual event.

Examples of applications

The area establishment file is the only compulsory national application. It was introduced in 1979 in all education areas and acts as common root for all the other applications.

Pupil management

- For the secondary level, institution of an information system in the form of an "area file" for the forward management of enrolment and the collecton of statistics. This is used by 7 education areas (out of 27).

- An "examinations" application for the secondary level which enables areas (22 use it) to run all the examinations organised by the Minister of Education at this level.

- 70 universities (out of 76) have set up management applications on the basis of a student's data file (enrolment procedures and continuous monitoring of administrative and academic situation). The system makes homogeneous national statistics possible for use at national or regional level together with a set of indicators showing the situation of higher education. In addition some universities have developed management applications for university examinations.

Staff management

Procedures for monitoring "staff movements" are applied to administrative and teaching staff administered at the national level. For staff administered at the regional or département level a set of individual and collective computerised management applications has been developed since 1971. These parametered management models can be applied to any body of staff and to local situations. The intention is that this package of applications will eventually be adopted generally throughout the country for all staff categories.

Financial management and accounts

In this field, the applications have to comply with the regulations for public accounting. Accompanying the decentralisation of funds to the regional authorities, an "area financial and accounts management" application is being introduced gradually in all the education area offices.

Experiments are in progress in three areas on the "financial and accounts management of secondary level establishments".

Costs

In 1982 the computerised management budget totalled 108 million francs or 0.11 per cent of the National Education budget (not including universities). The breakdown was as follows:

- 51 million francs, pay and social insurance costs of computer staff;
- 57 million francs, operating costs (rental of hardware, telecommunications, etc.)

For purposes of comparison, the computer budget in other ministries averages 1.6 per cent of the total.

It was estimated at that date that, to be effective, resources in terms of staff and appropriations would need to be multiplied by a factor of four.

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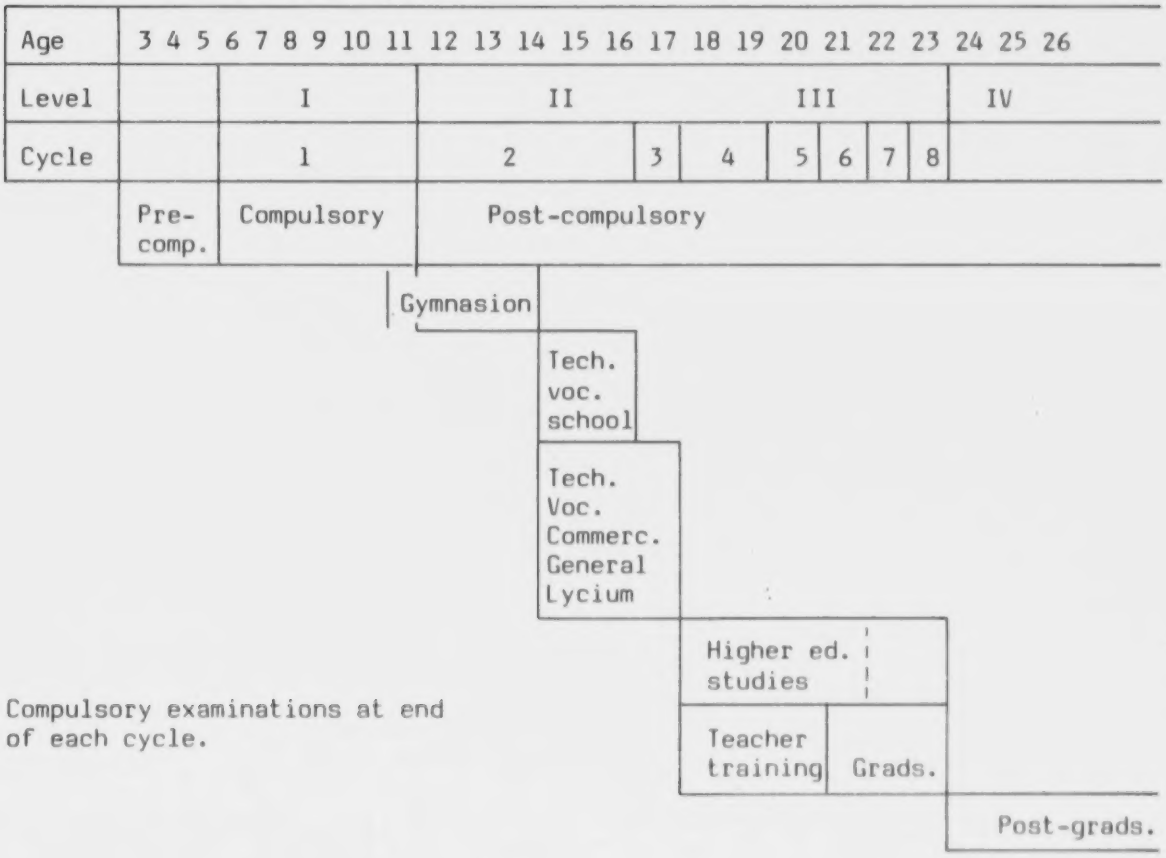
G R E E C E

Basic data

Total school population: 1 758 000 (1979)

Education budget: 31 754 307 000 drachmas (1979)
as percentage of GNP: 2.2%

Structure of educational system:



Compulsory examinations at end of each cycle.

	School population per level	Number of teachers per level
Primary	900 641 (1980)	37 315 (1980)
Secondary	740 058 (")	39 571 (")
Tertiary	117 407 (1979)	7 932 (1979)

In Greece, as in other countries, the new information technologies are invading all spheres of life. The Greek educational system, unlike that in other OECD countries is well behind meeting the emerging educational needs. So far approaches have been developed to meet only the most obvious and urgent demand: that for specialists.

Until their recent closure by government decision, private institutions gave such training. Other training - still operative - is given by manufacturers and a state agency, the Productivity Centre, the latter providing a two-year course for secondary school-leavers.

More recently, courses have been organised for young unemployed graduates with help from the EEC. These are three-month courses made up of 330 hours of theory and the same number of practical work in a firm.

LOWER SECONDARY EDUCATION

Curriculum
Computer appreciation

A few general lessons on data processing (what it is and the role it may play in daily life) are scheduled for the physics lessons in grade 9. Given the absence of computer equipment, the instruction remains theoretical and it is not certain whether these lessons are actually given.

UPPER SECONDARY EDUCATION

Nothing exists in general schools.

Data processing is included in certain courses in vocational training establishments.

In vocational training establishments, lessons on data processing are given in some courses.

Source: Document CER/NT/84.02 (OECD)

HUNGARY

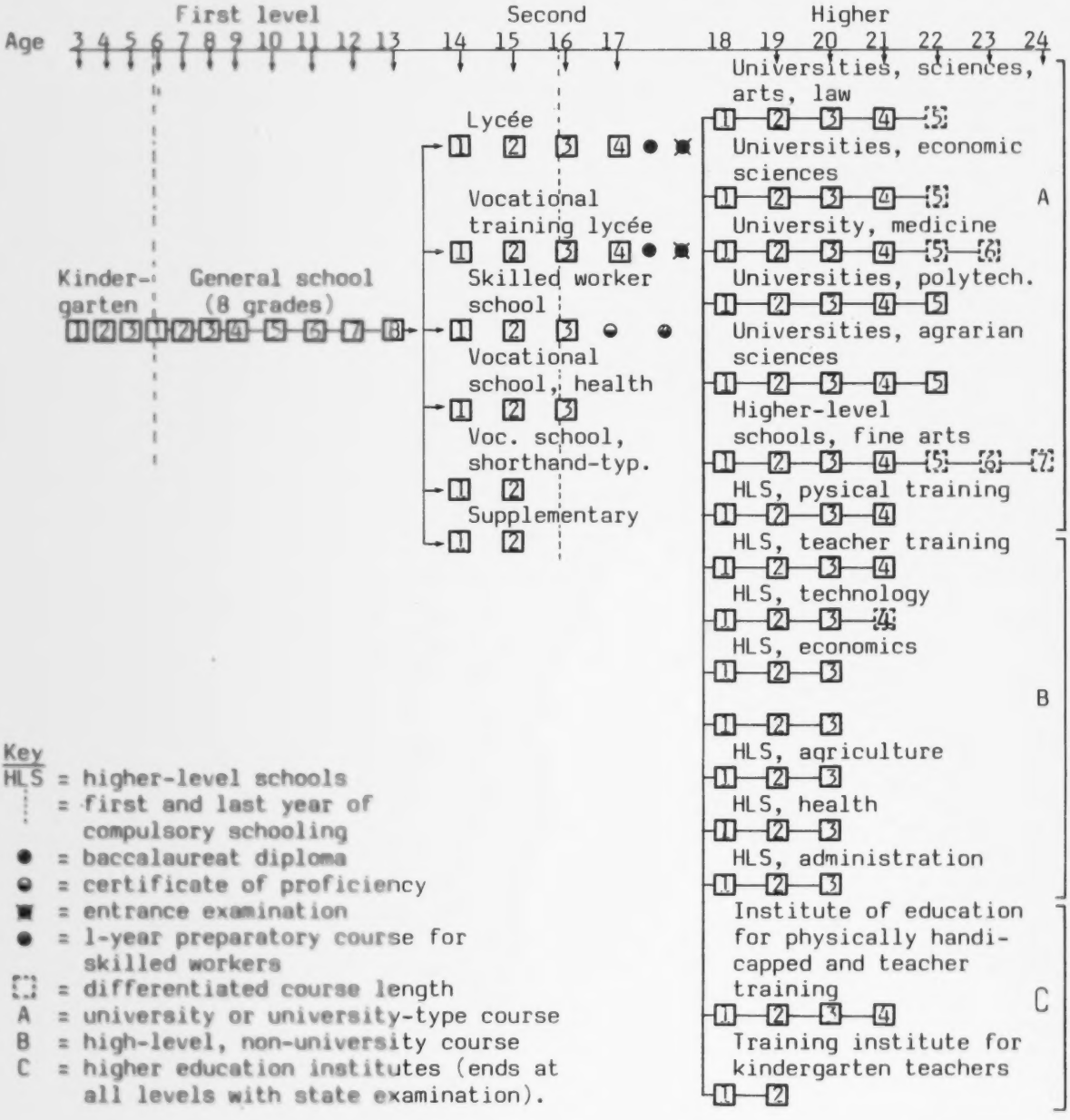
Hungarian People's Republic

Basic data

Total school population: 1 710 287

Budget for education, culture and scientific research: 52 113 000 Forints
as percentage of GNP: 9.2%

Structure of educational system:



Key

HLS = higher-level schools
⋮ = first and last year of compulsory schooling
● = baccalaureat diploma
◒ = certificate of proficiency
▣ = entrance examination
● = 1-year preparatory course for skilled workers
⬚ = differentiated course length
A = university or university-type course
B = high-level, non-university course
C = higher education institutes (ends at all levels with state examination).

	School population per level	Number of teachers per level
Primary (age 6 to 14)	1 286 648	86 367
Secondary (age 14 to 18)	423 639	29 512

Number of computers in use in education (secondary level): 1512

Key dates in the introduction of informatics in the education system

1979-81 During this period the Scientific Research Management Institute works out various informatics teaching proposals for the purposes of the VIth five-year Plan (1981(85) and a central programme for the development of informatics is approved by the Plan Committee in 1981.

1982 The Minister of Education is made responsible for implementing the programme for the teaching of informatics in the five-year Plan. The Plan sets the following objectives:

- To dispense basic knowledge of informatics and its applications in secondary education.

- To develop the teaching of computer science in institutions of higher education.

A competition is launched for the supply of school computers.

1983 Each of the 761 secondary establishments receives at least one computer (810 units in all). Teacher training begins in the form of short courses and 1700 people take part. A software competition is held.

1984 Secondary schools receive a further 600 computers. The National Educational Technology Centre organises advanced training courses for teachers and sets up a national network of inspectors to monitor progress in the implementation of the school informatics programme. 300 programs are distributed coming either from the software competition or from the output of the TEACHSOFT association.

The bodies involved at national level and responsible to the Ministry of Education are the Institute for the Management of Scientific Research and Informatics, the National Educational Technology Centre and the National Pedagogic Institute.

PRIMARY EDUCATION

The introduction of informatics is planned for the 1985-86 school year on an experimental basis in 10 per cent of schools (i.e. 200-300). It will reach 10 per cent of the primary school population - about 60 000. Each of the schools selected for the experiment will receive 4 to 8 Commodore-16 computers. The schools are required to report on the way the experiment turns out in order to evaluate results before the project is adopted generally.

The object of the operation at this educational level is to familiarise children with the basic concepts of computer science through the teaching of mathematics, physics and technology.

SECONDARY EDUCATION

Hardware

The first step in the introductory programme was to decide on the computers to be given to the schools. The choice fell to the HT 1080Z (the "school" computer built by the telecommunications cooperative), the ABC 80 (made by Luxor in Sweden) and the Commodore-64 complete with printer. The ABC-80 and the HT 1080Z have a screen and a tape recorder.

761 schools were fitted out with a total of 1512 computers (preponderantly the HT 1080Z) and a count at the start of the 1983/85 school year showed that 56 per cent of schools had one microcomputer, 34 per cent had two to four and ten per cent had between five and 23. On average there is one computer for every 265 pupils.

In 26 per cent of cases, the schools themselves provided the funds from their own budget.

Although no rule was imposed as to the purchase of hardware, efforts were made to ensure homogeneity in order to facilitate software portability and distribution.

Computer hardware budget at national level

Year	Item	Amount (million Forints)
1984	Purchase of computers	22
	Programme development	4
1985	Purchase of computers	40
	Programme development	4

Source: Institute for the Management of Scientific Research and Informatics, Budapest, 1985.

Applications

The introductory programme, whose central purpose was to ensure general acquisition of the rudiments of computer science, continued with the revision of the mathematics, physics and technology curricula. The new content should begin to be taught during the 1985-86 school year.

In the meantime, the computers are used in the framework of "computer study circles" organised in each establishment. In the 1983-84 school year there were 1500 such circles for beginners and 350 of a more specialised kind involving a total of 2 700 schoolchildren working on computers one and a half to two hours a week.

Another type of application is CAI, the software developed in the framework of the national programme relating to most of the subjects taught in secondary schools.

The teaching of computer science itself will be concentrated in mathematics, physics and technology lessons. Some lycées are already giving optional computer operator courses as a feature of vocational training.

Software

In the software competition in 1983, 459 projects were entered and 156 accepted. All were produced by students or teachers.

Secondly, TEACHSOFT (an association for the development of courseware) has been formed by a number of institutions, its first product being courseware for the teaching of higher mathematics.

A total of about 250 programs are available to schools, generally written in Basic and in Z80 assembly language. Before issue the software is evaluated and validated by specialists.

Teachers

The mathematics, physics and technology teachers responsible for teaching computer science have been receiving instruction in this special subject in their initial training since 1975. For other teachers, special further training arrangements have been defined: basic courses for beginners, maintenance courses and supplementary university courses for which a diploma is awarded.

When the schools were issued with their computers, 2 400 teachers were given basic training. During school year 1984-85, 2 900 teachers went on the further training courses organised by th National Educational Technology Centre either at central level or via the Further Training Institutes in the counties with the assistance of the national inspectors network.

EXTRA-MURAL

Various computer training schemes have been launched outside the formal educational system at the same time as the national programme. They include the following:

- Teacher training schemes and school computer competitions organised by the Van Neumann society.
- Computer camps run by the Union of Communist Youth.
- Courses organised by the Culture Centres equipped with the same computer hardware as the schools themselves.
- Computer broadcasts (series of 16 programmes called "TELEBASIC") produced by Hungarian Television, the Enterprise for Computer Applications and the Van Neumann Society. Viewers following the programmes are able to sit an examination at the end of the series.

- A multimedia package named "Microcomputers" consisting of 15 modules and including both written and audiovisual material co-produced by the Hungarian Enterprise for Film Production, the Institute for the Management of Scientific Research and Informatics and the National Educational Technology Centre.

Source:

- Institute for the Management of Scientific Research and Informatics: Note on the school informatics programme, Budapest, 1985.

I C E L A N D

Basic data

Total school population:	56 000 approx. (1982)
Education budget:	78 100 000 Krona (1975)
as percentage of GNP:	4.1%
Structure of educational system:	Not available

	School population per level	Number of teachers per level
Primary	25 018 (1982)	1 380 (1975)
Secondary	26 627 (")	2 387 (")
Tertiary	4 383 (")	575 (")

Key dates in the introduction of informatics in the education system

1965 Computer studies are started in higher education

1971 Computer studies are introduced in upper secondary schools (grades 12 and 13)

1978 Computer studies are introduced in secondary schools (Grades 10-13), especiaslly in the commercial education sectors.

1980 Vocational schools begin offering computer courses to most of their students whereas such training had begun earlier in electricity and electronic courses and later has been extended to graphic arts programmes.

1982 The Ministry of Education sets up a task group to evaluate the situation and to make recommendations for further planning. The group has compiled a report including a variety of proposals.

Current situation

The Ministry of Education is preparing a curriculum in computer education for compulsory schools and university colleges of education to be completed by the autumn of 1984. In addition the Ministry has asked for bids to be submitted for microcomputer systems to be purchased for schools. Decisions on which equipment to be buy will be taken in 1984.

Current policy efforts aim at equipping schools with more hardware and developing teacher training arrangements. Software development has started with the private sector indicating its readiness to adapt and develop software for educational purposes. It is not uncommon in Iceland to make use of textbooks written in English or in one of the Scandinavian languages, especially in the upper secondary schools; the same will apply to software.

A development plan exists in which the aim is to finance the purchase of at least two microcomputers for every school in the country.

The intention is to include informatics and computer literacy in the compulsory school curriculum but the exact content is still to be determined.

There is also a development plan for the new audiovisual technologies. The Ministry of Education has set up an advisory group on the use of the new information technologies and their impact on schools. The group is headed by a computer expert from the university of Iceland and includes representatives of the teaching staff at compulsory and secondary schools.

The National Centre for Educational Materials will develop software in accordance with the new computer curriculum plan for compulsory schools. Software for the other stages will be developed, adapted or used in the original language.

Some in-service courses for teachers of all grades are offered at the universities. A considerable increase is planned in this area.

PRIMARY EDUCATION

Hardware

Several schools are equipped, so far financed by the local authorities.

Teacher training

Several courses in computer studies have been offered at the University College of Education.

SECONDARY EDUCATION

Hardware

Virtually all secondary schools have one or more microcomputers.

Teaching of informatics

Typical courses of 4 hours a week, for 34 weeks, are run during the first two years of upper secondary school.

Software

Software comes mainly from commercial sources.

Teacher training

Courses in computer education have been offered to teachers at the University of Iceland as well as in-service courses in several schools.

Source:

- Document CERI/NT/84.02 (OECD)

I N D I A

Basic data

Total school population: 104 million approx.

Education budget: 44 102 million Rupees (1981)
as percentage of GNP: 3%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I II III IV
Cycle	Primary Secondary (lower | upper)
	Teacher training
	University Higher education

There is a great variety of structures across the country.

	School population per level	Number of teachers per level
Primary	72 687 840 (1980)	1 345 376
Secondary	23 831 558 (1977)	
Tertiary	5 345 580 (1979)	277 468

The Constitution delegates the administration of education to the States but the central government is directly responsible for the formulation of norms governing higher education and research, scientific and technical establishments and university administration. Each state has its own Ministry of Education. The central government and those of the states deal with vocational and technical training and certain management training areas on a joint basis. Educational planning is the responsibility of both the central government and the states, following the guidelines laid down by the Planning Committee. Education is largely financed by the central government; other sources are the authorities at state and local level, school fees, foundations and donations.

Political and industrial background

National education policy affirms the need for the new technologies to be made use of in informing and educating the people with the object of bringing the national development plan to fruition. On that score, educational technologies are regarded as an ideal means of improving and extending education programmes. For these reasons government policy recognises the need to familiarise children with computers and their applications in working and everyday life. That is the objective of a pilot project recently launched in 250 schools in the country (see Secondary Education below).

The Indian electronics industry is now in a position to produce intermediate size computers which will be marketed by Electronic Corporation of India, Ltd. Thanks to the stimulus imparted by the government, some fifty firms are manufacturing micro and mini-computers and a hundred others are on the point of entering the market.

A feature of industrial policy is the effort to standardise production (standardisation of operating systems and peripherals) so that component compatibility may enable standardised microcomputer assemblies to be produced at lower cost.

Software production capacity has grown at the same time and India is now a software exporter (exports in 1983 were worth 130 million rupees).

Present situation

Aside from the pilot project referred to below, informatics has been so far almost exclusively confined to higher education the reason being the many difficulties in the way of adopting a plan for the introduction of informatics in education at the national level. The main problems are as follows:

- The diversity of the educational context in different parts of India.
- The size of the country and the school population.
- Regional disparities in development, the low level of urbanisation and the lack of infrastructures in rural areas.
- The multilingual nature of Indian society.
- The lack of resources which means that educational priorities have to be set in a context where illiteracy remains a major problem.

Institutional context

The institutions involved in the field of the educational applications of informatics are as follows:

- Five technology institutes at Bombay, Delhi, Kharagpur and Madras.
- Jadavpur University.
- The Indian Institute of Sciences at Bangalore.
- The Tata Institute of Fundamental Research at Bombay.
- The National Council of Educational Research and Training (NCERT) at New Delhi and Mysore.
- Several schools for engineers and technical institutes for teacher training, which are beginning to design software and hardware for schools.
- Numerous hard and software manufacturers also interested in the education market.

SECONDARY EDUCATION

Pilot project CLASS (Computer Literacy and Awareness in Secondary Schools) launched by government decision in 1984.

Objectives

The general aim of the project is to prepare children for their present and future technological environment: demystification of the computer and familiarisation with various applications and with computer operation so as to develop individual creativity. The intention is also to encourage teachers to use information technologies in improving the effectiveness of their teaching and for this reason programs are chosen that do not change but strengthen the teacher's traditional role and make the most of the teacher's capacities.

Computers are thus used in the project as tools with which children have to familiarise themselves and as aids to curricula.

Infrastructures

250 secondary establishments are taking part in the project, some coming under the central government, some under state governments and some being private schools.

42 resource centres from the network of universities and schools for engineers have been selected to train teachers, define teaching programmes and strategies, provide technical assistance and be responsible for maintenance for the participating schools.

Given the widely scattered school distribution and the impossibility of having an individual maintenance service in each, a system of replacing - instead of repairing - defective parts has been set in place by a government institution called the Computer Maintenance Corporation.

750 teachers (in business techniques, mathematics and science) were trained by means of a three-week crash course in July-August 1984.

A uniform programme has been formulated even though school curricula vary greatly from state to state.

The programme aims mainly at problem-solving using programming simulation software. There is no teaching of programming itself.

The coordination of research and software production activities is the reponsibility of the NCERT at New Delhi.

HIGHER EDUCATION

Although higher education has been offering computer science courses for several years now, qualified staff requirements greatly exceed the training capacities of the educational establishments and it is this lack of qualified instructors that is the biggest obstacle to the development of training at all levels.

Informatics is used as a reearch tool in the universities and schools for engineers and specific applications are being developed in the fields of industrial design, CAD and management.

Outside the network of higher education establishments, a professional organisation, the Indian Informatics Company, offers further training and refresher courses.

FUTURE DEVELOPMENTS

Teacher training

Given the shortage of specialists and trained teachers at all levels steps need to be taken to build up an infrastructure based on the universities, schools for engineers and polytechnic institutes. Mini-courses for the retraining of teachers from other disciplines are being considered and a package of incentives to induce specialists from industry and second and third cycle students to give part-time training is being put together.

The inclusion of computer science in student-teachers' initial training course is also recommended, together with an extension of in-service training arrangements in order to make good qualitative and quantitative shortfalls. The use of the mass media is envisaged to this end.

Hardware and software

Applied research is in progress in the field of hardware and software: local production of tropicalised hardware, computer handling of Indian languages, production of graphic software, adaptation of existing software to the national languages, etc.

Work is also going ahead on the downloading of software as a way of facilitating distribution and reproduction.

Extra-mural

There are plans for fitting out mobile units which would travel round the country and thus make up for the scarcity of information and training infrastructures and the lack of qualified teachers and develop public interest in information technologies.

Source:

- Final report of the third Asian seminar on educational technology held in Tokyo on 26 Sep. to 2 Oct. 1984 (APEID 1984).

I R A Q

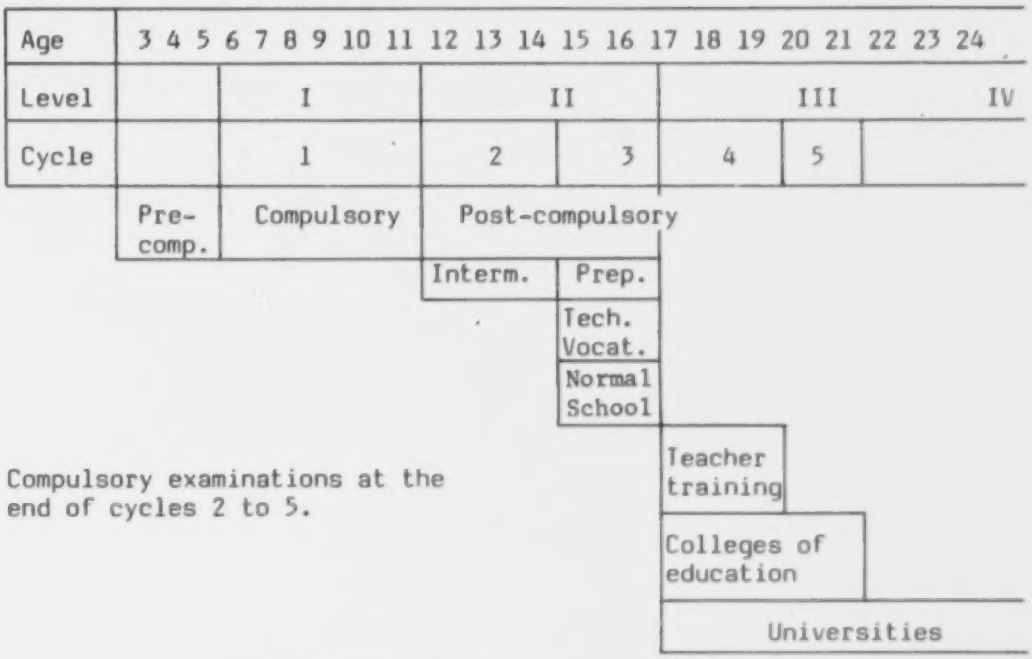
Basic data

Total school population: 3 809 214 (1982)

Education budget:

as percentage of GNP:

Structure of educational system:



Compulsory examinations at the end of cycles 2 to 5.

	School population per level	Number of teachers per level
Primary	2 620 883 (1982)	107 479 (1982)
Secondary	1 065 588 (")	38 678 (")
Tertiary	122 743 (")	6 893 (")

APPLICATIONS

Secondary education

The introduction of informatics in the public educational system began in 1977 when experiments were launched on an Iraqi language called "Algorithme" (Alkhowarizmi). Since that date the use of this language has been extended to first cycle classes in secondary education.

Source:

- Introduction of informatics in the educational system of the Arab world. Regional Office for education in the Arab countries. Unesco, Nov 1985.

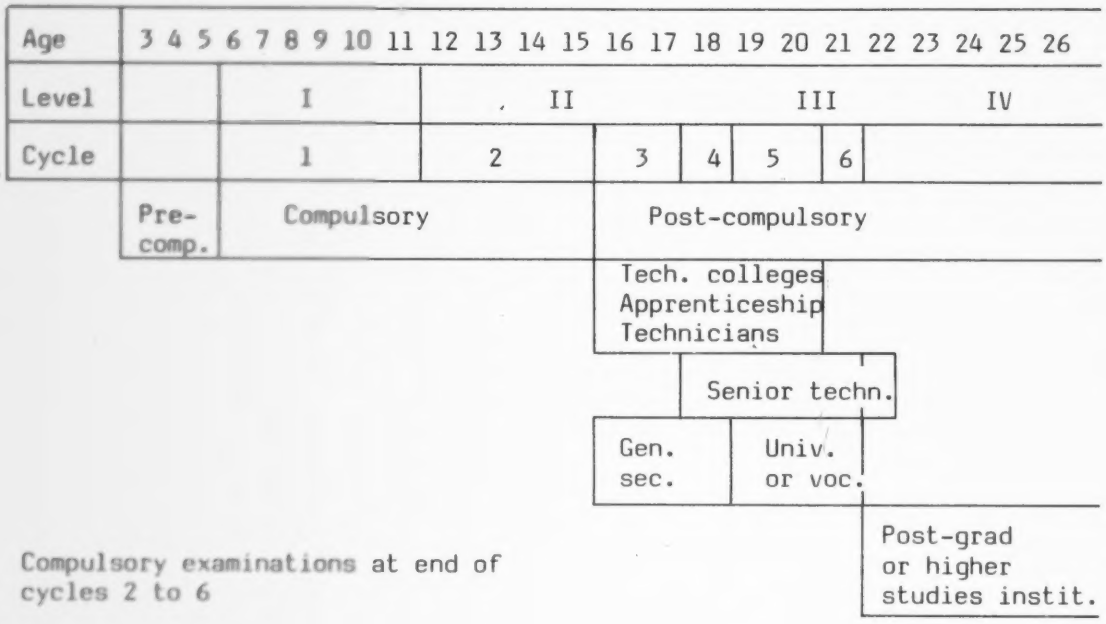
I R E L A N D

Basic data

Total school population: 790 300 approx. (1981)

Education budget: 596 162 000 Pounds (1980)
as percentage of GNP: 7%

Structure of educational system:



Compulsory examinations at end of cycles 2 to 6

	School population per level	Number of teachers per level
Primary	420 871 (1981)	14 829
Secondary	309 600 (")	19 705 (1979)
Tertiary	59 824	5 572

Key dates in the introduction of informatics in the educational system

(Report by the Commission of the European Communities in 1983)

1970 An International Conference organised by the OECD launches the debate on the introduction of the new information technologies in education.
First efforts concentrated on in-service teacher training.

1973 The Computer Education Society of Ireland (CESI) is created. The Society publishes a periodic newsletter and receives grants from the Department of Education.
During the decade 1970-1980, significant industrial developments took place in the country: the resulting demand for trained personnel exceeded by far the capacity of the educational and training system.
Some schools purchased computer equipment out of local or private funds.

1978 An indigenous Irish computer group initiates an annual "Memory Ireland Computer Competition" which is open to all schools and provides opportunities for pupils to present individual and group projects on topics relating directly to computers and their applications.

1979 The Ministry of Education sets up an Advisory Committee to study the introduction of the new information technologies in education taking into account the existing institutional structures and conventions.

1980 The White Paper on Educational Development is published announcing formally that computer education will be introduced into secondary schools.
As an interim measure, the Department of Education establishes an introductory course in Computer Studies in the Senior Cycle Programme as an optional component of the mathematics syllabus. 7% of secondary schools are involved in 1980-81. During the following two school years the figure grows first to 20 and then to 37%.

1981 In November, the Advisory Committee submits its report to the Department of Education. It recommends:

- A familiarisation course in the new information technologies for pupils at the junior cycle.
- A course in computer studies of a general nature at the senior cycle level.
- A number of vocationally oriented courses for particular groups at senior cycle.
- A general briefing course for senior cycle level not taking Computer Studies as a full subject.

1982 An equipment policy for secondary schools is started by the Department of Education under a bulk purchase system.

Current situation

The educational system is still evolving under the primary demand for a technologically educated labour force. The secondary cycle is the one considered at the policy level. Efforts cover curriculum development, teacher training and equipment. No policy exists as yet for software production or diffusion.

PRIMARY EDUCATION

Hardware

Only one school (associated with a primary teacher training institution) has publicly-financed computer equipment. It has been supplied with a microcomputer for experimental purposes.

Curriculum - computer appreciation

Primary school pupils are made aware of the role of the computer in modern society in the programme for Mathematics, Social and Environmental Studies. Educational visits to local industries are arranged occasionally during the school year.

SECOND CYCLE SECONDARY EDUCATION

Hardware

Over two-thirds of general secondary schools have computer equipment.

Financing

Most equipment is purchased with funds from the Department of Education. Some schools have themselves paid for supplementary equipment.

Curriculum - computer science

Currently pupils at about 350 schools take computer studies as an optional module at the Mathematics "O" level.

Software production

A standardised version of the Comal 80 computer language has been made available to schools to facilitate (a) portability of software, (b) development of good standards in program design.

Teacher training

Initial teacher training courses are organised by universities and teacher training colleges. Trainee teachers in Science, Mathematics, Commerce and related subjects are given courses in the new information technologies. In addition, some universities offer part-time post-graduate courses in Computers which are attended by teachers. In-service courses in computers are organised by the Department of Education. Attendance at these courses is voluntary. The majority of the lecturers on these in-service courses are themselves teachers. Approximately 5% of all secondary teachers have attended these courses.

VOCATIONAL EDUCATION

The situation is currently under review following a report on an Advisory Committee. Some vocational courses, e.g. courses orientated towards office skills, have relevant aspects of information technologies as course elements.

Source:

- Document CERI/NT/84.02 (OECD)

I T A L Y

Basic data

Total school population: 10 635 000 approx. (1982)

Education budget: 13 633 022 million Lire (1980)
as percentage of GNP: 5%

Structure of education:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26				
Level		I	II	III	IV
Cycle		1 2 Elementary	3 Sec.	4 Intermediate	
	Pre-comp.	Compulsory		Post-compulsory	
				Sec.schools (Licei)	University faculties
				Technical institutes	and institutes
				Teacher tr. inst.	2 yrs univ.
				Colleges of educ.	
				Vocat. instit.	

Compulsory examinations at end of cycle 3.

	School population per level	Number of teachers per level
Primary	4 215 841 (1982)	279 082 (1981)
Secondary	5 328 542 (")	526 431 (")
Tertiary	1 090 775 (")	48 787 (1982)

Present situation

In a country where major educational reforms have been debated in Parliament over the recent years, it is perhaps not surprising to find that no overall national policy exists as yet to introduce the new information technologies in education. Vocational training is the only sector where any policy developments have taken place, mostly in connection with the training of specialised manpower.

The absence of formal initiatives by the State outside vocational and technical education is, however, counterbalanced by the existence of a number of experiments by individual schools, research institutes and local (regional, provincial and municipal) authorities. Studies on the educational applications of videodiscs are being carried out by six research institutes and by the education department of the national television corporation and the educational applications of computer technology are being investigated in nine university centres and by some local education authorities.

Teacher training provisions in this area are very scarce and, so far, limited to teachers of science subjects.

Source: Report of the Commission of the European Communities, 1982, quoted in OECD document CERI/NT/84.02.

I V O R Y C O A S T

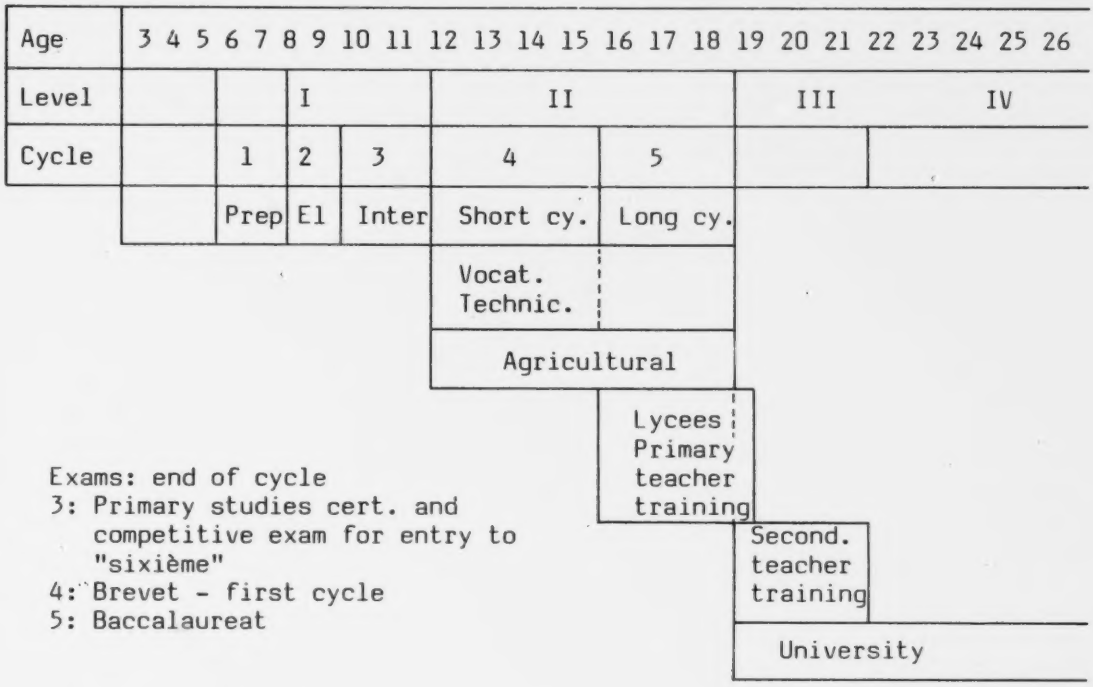
Basic data

Total school population: About 1 200 000

Education budget: 160 092 300 000 Francs CFA (1980)

as Percentage of GNP: 7.6%

Structure of educational system:



Exams: end of cycle
3: Primary studies cert. and competitive exam for entry to "sixième"
4: Brevet - first cycle
5: Baccalaureat

	School population per level	Number of teachers per level
Primary	954 190 (1979)	24 441
Secondary	214 298 (1979)	
Tertiary	18 732 (1981)	1 204

Background

The National Data Processing Commission (CNTI) was set up in 1980 to draw up a computer plan for the period 1981-85. The computerisation strategy it defined has the following objectives:

- To have a sufficient number of computer specialists at the various levels of skill.
- To build an initial and further training structure to meet the country's requirements.
- To encourage the national development of certain slots in the computer industry that will help to consolidate the strategy of independence.
- To organise the development of computer use in the administration and to use it as an instrument of administrative reform.

The main avenues where the plan of action is operative are the computer industry, telecommunications, research, the contribution to administrative reform and international cooperation.

The machinery responsible for putting the plan of action into effect is at three levels:

- The National Informatics Commission (CNI) responsible for the direction of national computerisation policy;
- The Secretariat-General for Informatics (SGI), a public agency coming directly under the President of the Republic, which is responsible for providing the drive behind the national computerisation policy;
- The Ministerial Informatics Commissions (CMI) which are responsible for producing a master plan for computerisation in each ministry and seeing that it is carried out.

The whole scheme has been delayed by several years because of economic difficulties but the government does not intend to give up its computerisation objectives, 1985 now being the year when the plan should operate.

The intention is to launch 4 pilot projects with a total budget of 251 million CFA. An industrial project for the installation of a maintenance unit and a microprocessor assembly plant in the Ivory Coast is being considered.

Two of the four projects are rural development applications (agrofood databank and ministerial management instrument), the third concerns public health (epidemic control) and the fourth is a computer awareness project in which pilot outposts of the Ministry for National Education and Scientific Research are to be opened.

Computers in use

In 1980, 275 computers were counted in the country. 1 000 systems should be in service by 1985. All systems are imported and marketed (via their local distributors) by the big manufacturers (including IBM, BURROUGHS and CII) which share 90% of the market in value terms.

Out of the 25 computer service and consultancy companies operating in 1980, 13 controlled 80% of business in the software development sector.

Applications

Computer operation is mainly in the hands of private firms (which had 76% of the computers in use in 1979). 90 per cent of applications relate to management and the handling of statistics, 10 per cent being scientific applications.

Manpower

In 1980 the count of people working on computers was 2 000 including 130 design engineers and project leaders, 65 analysts, 224 analyst programmers and programmers and 680 operators. Research staff included a sizable number of foreign engineers (29 per cent in all and, for the computer service and consultancy companies who employed 460 people in 1980, 74 per cent).

Growing market needs (1 000 systems in service by 1985) mean an increase in manpower requirements, estimated at 4oo design engineers, 400 analysts and 1 300 computer operators.

APPLICATIONS

Higher education/teaching of informatics

Between 1974 and 1980 the training of manpower for computer jobs was a matter of piecemeal initiatives run in collaboration with the ISTO (Institute of organisational sciences and technologies) and the IFG (French institute of management).

The Ivory Coast also uses permanent sub-regional training structures such as the IAI (African informatics institute) set up in Libreville in 1971 under the auspices of the OCAM. The IAI supplies each member state with 4 analyst-programmers a year, trained in three years. The opening of a higher cycle for the training of design engineers is planned for 1985-86.

Local training facilities include the Higher Institute of Informatics, attached to the INSET, which has a three year analyst-programmer course. A course for systems designers is on the drawing board.

Software

The Institute for mathematics research is developing software for educational and medical purposes.

Administrative management applications

The Statistics and Informatics Directorate at the Ministry of Education and Scientific Research produces educational statistics.

Informal education

There is a Microtel club in the Ivory Coast.

Sources:
- L'informatique dans l'éducation en Afrique de l'Ouest. Document produced for BREDA by S. Dioum , DTAI, Dakar, BREDA, Nov 1984.
- Ressources/Informatique No. 6, Dec 1984.

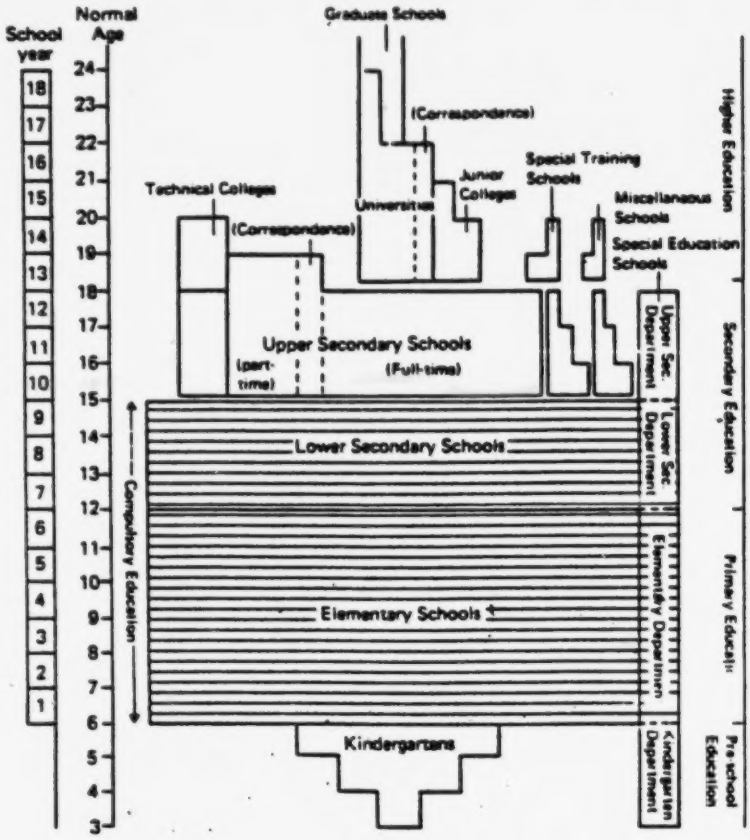
J A P A N

Basic data

Total school population: 24 300 000 approx.

Education budget: 14 906 759 000 Yen (1981)
as percentage of GNP: 6%

Structure of educational system:



Organization of the School System of Japan

There are three types of educational establishment:

- National institutions under the central government authority.
- Public institutions under the local authorities.
- Private institutions in private hands.

The two levels of decentralisation are the regions which administer second cycle secondary education and higher education and the municipalities which administer primary and first cycle secondary schools.

At primary and secondary (first and second cycle) levels education is organised and curricula decided by the Ministry of Education, Science and Culture. Within the general framework defined by the Ministry schools may adapt or supplement curricula to suit local situations but at university level curricula definition is entirely the business of the establishments themselves.

For the secondary level (second cycle) the equipment of schools with computers is laid down in the Act on the promotion of science education.

	School population per level	Number of teachers per level
Primary	11 901 000 (1982)	475 000
Secondary	10 011 340 (1982)	553 684
Tertiary	2 391 915 (1982)	225 507

Number of computers used in education:
Universities: 1168
Secondary schools: 499
Other establishments: 325

N.B. These figures seem to relate only to the bigger computers (mainframe and minicomputers) since another source (country report of Japan, 1984) speaks of 4 000 machines in secondary education including 3 500 microcomputers.

Key dates in the introduction of informatics in education

1969 The Proposal for Promoting Instruction in Information Processing is issued. It will play a major role in introducing the new information technologies in upper secondary schools, starting with industrial and commercial education. The report stresses the importance of instruction in these technologies to achieve social and economic progress in the country. To gain this broad objective the report focusses primarily on action at the upper secondary level and proposes the simultaneous development of equipment and teacher training. It also recommends the setting up of Information Processing Instructional Centres.

1970 The Course of Study for Upper Secondary Schools is issued by the Vocational Education Division of the Ministry of Education. Funds from the National Treasury under the Act for the Promotion of Vocational Education pay for the equipment of a number of schools. Three-month training courses for teachers and other educational staff begin in Tokyo and Osaka; total attendance: 60.

1978 The Course of Study for Upper Secondary Schools is updated. Nearly all industrial and commercial schools have since incorporated the instructional programmes outlines in it.

Present situation

In May 1985 the Department of Social Education in the Ministry of Education, Science and Culture issued a report by an ad hoc committee on the Use of Microcomputers in Education and in August 1985 the Department of Primary and Secondary Education issued an interim report on the Future of Primary and Secondary Education in the Information Society. The purpose of these reports is to give guidance for policy on computers in education.

The Ministry of Education has defined a plan for subsidising the cost: it will pay 50 per cent of the cost of equipment in compulsory education and one third of the cost in second cycle secondary. In 1985, 2 000 million Yen are to be invested by the Ministry in this way. The Interim Report of the Department of Primary and Secondary Education sets a twofold objective for the introduction of information processing in the classsroom: to improve education (CAI, computer assisted learning, etc) and to teach computer science in secondary schools.

The local school authorities are urged to launch experimental projects in the two directions and thus to be eligible for public grants.

The Ministry of Education's policy on information processing is to be officially announced early in 1986.

Supplementary information

Research groups working on computer applications in education:

- Study group on Educational Technologies (Japanese Institute of Electronics and Communications Engineers.
- Japanese Society for Computer Assisted Instruction.
- Society for Science Education.
- Council of National University Educational Technology Centres.

Questions of information processing in education come under three ministries which act in cooperation: first and foremost the Ministry of Education, Science and Culture but also, in an advisory role or as technical experts, the Ministry of International Trade and Industry (MITI) and the PTT Ministry .

STATISTICAL DATA

Numbers of computers in elementary and secondary schools

Type of school		Schools having computers	Total schools	Ratio (%)	Average number of computers in a school
Elementary schools	Public	27	24 802	0.1	1.1
	Private	9	168	5.4	2.4
	Total	36	24 970	0.1	1.4
Lower secondary schools	Public	94	10 252	0.9	1.3
	Private	100	550	18.2	3.1
	Total	194	10 802	1.8	2.2
Upper secondary schools	Public	1 970	3 954	49.8	3.9
	Private	400	1 242	32.2	4.8
	Total	2 370	5 196	45.6	4.1

(Source: CMI in Japanese Secondary Schools - Unesco 1984)

Another source - Country Report of Japan 1984 - gives the following equipment ratios:

- pre-school: 0.32%
- primary: 0.58%
- first cycle secondary: 3.09%
- second cycle secondary: 56.38%.

The average for the educational system as a whole is given as 9.84%.

For the number of machines per computer-equipped school, the same source gives the following figures:

- pre-school: 1.00
- elementary: 1.78
- first cycle secondary: 1.37
- second cycle secondary: 4.20
- national average: 3.92.

Utilisation of mucrocomputers in schools

Type of school		Number of schools with				Number of schools having computers
		CAI	CMI	Computer education	Student Club activities	
Primary	Public	23	6	0	15	27
	Private	2	8	0	2	9
	Total	25	14	0	17	36
Lower secondary	Public	31	60	2	32	94
	Private	18	76	2	31	100
	Total	59	136	4	63	194
Upper secondary	Public	688	1 209	318	766	1 970
	Private	131	294	59	111	400
	Total	819	1 503	377	877	2 370

(Source: CMI in Japanese Secondary Schools - Unesco 1984)

Installation and utilization of microcomputers in elementary and lower and upper secondary school

Classification		Conditions of Installation				Areas of Utilization							
		Total Number of Schools	Number of Schools with Computers Installed	Percentage of Schools with Computers Installed	Average Number of Computers	CAI		CMI		Computer Education		Club Activities, etc.	
						Number of Schools	%	Number of Schools	%	Number of Schools	%	Number of Schools	%
Elementary Schools	Public	24,802	27	0.1	1.1	23	85.2	6	22.2	0	0.0	15	55.6
	Private	168	9	5.4	2.4	2	22.2	8	88.9	0	0.0	2	22.2
	Total	24,970	36	0.1	1.4	25	69.4	14	38.9	0	0.0	17	47.2
Lower Secondary Schools	Public	10,252	94	0.9	1.3	31	33.0	60	63.8	2	2.1	32	34.0
	Private	550	100	18.2	3.1	18	18.0	76	76.0	2	2.0	31	31.0
	Total	10,802	194	1.8	2.2	49	25.3	136	70.1	4	2.1	63	32.5
Upper Secondary Schools	Public	3,954	1,970	49.8	3.9	688	34.9	1,209	61.4	318	16.1	766	38.9
	Private	1,242	400	32.2	4.8	131	32.8	294	73.5	59	14.8	111	27.8
	Total	5,196	2,370	45.6	4.1	819	34.6	1,503	63.4	377	15.9	877	37.0

Notes:

1) "The Average Number of Computers" under "Conditions of Installation" refers to the average number of computers owned by the schools that have computers installed.

2) The percentage figures under "Areas of Utilization" refer to the percentage of schools with computers installed that use their computers for the area of utilization in question. If a computer is utilized in a number of areas within one school, its use will be counted separately with regard to each area.

Source : Information processing in Japan (1985)

PRIMARY EDUCATION

Hardware

No. of schools equipped: 36.

Percentage of total: 0.1% (average figure).
public schools: 0.1% with an average of 1.1 machines per school.
private schools: 5.4% with an average of 2.4 machines per school.

Another source gives an average figure of 0.58% with an average of 1.78 machines per equipped school. (See tables on pages 158 and 159).

Financing: Primarily the responsibility of the Ministry of Education and its local agencies (at prefectural and municipal level).

Types of application

Computer assisted instruction: Practical work (drill and practice) in mathematics and science. Given the number of computers available in schools it would seem that they are used more for simulation or to display data than for individualised CAI.

Computer science: The Ministry of Education curricula do not call for any computer science teaching in primary and first cycle secondary, so very few applications of this type are to be found at these two levels.

Software

Production: By the schools and teachers in higher education.

Pilot projects

Computer assisted instruction at Takezon Ohigashi primary school: This project was developed by the University of Tsukuba as of 1978 and is applied in the teaching of the natural sciences and mathematics. The hardware used is a Z 80 computer with 40 terminals. The software permits the use of Japanese characters.
N.B. This information dates from 1979 and is subject to verification.

Logo: A Logo-type system for mentally handicapped children with the title Practical Environmental System has been developed by the Education Faculty at Ibaragi University.

FIRST CYCLE SECONDARY EDUCATION

Hardware

No. of schools equipped: 194.

Percentage of total: 1.8% (average)
public schools: 0.9% with an average of 1.3 machines per school
private schools: 18.2% with an average of 3.1 machines per school. Another sources gives an average figure of 3.09% with an average of 1.37 machines per equipped school. (See tables on pages 158 and 159).

Financing: Primarily the responsibility of the Ministry of Education and its local agencies (at prefectural and municipal level).

Types of application

Computer assisted instruction: Used in mathematics and science.

Computer science: The Ministry of Education curricula do not call for any teaching of computer science at this level and therefore very few applications of this kind are to be found at this level.

Software

Production: By the schools and teachers in higher education.

Pilot projects

Computer assisted instruction in Tokiwa secondary school: This project was developed by Tsukuba University (Science Information Processing Centre) as of 1974. It is applied in the teaching of mathematics (9 000 terminal/hours a year for the three years of the course. An OKITAC 4500 C minicomputer is used with 20 terminals. The software enables lessons to be generated from sequences stored in the memory and its facilities include continuous assessment and the handling of mathematical symbols and graphics. It operates in the conversational mode.

Computer assisted instruction at Koyamadai secondary school: This project, presented as a low-cost CAI system, was developed by Tsukuba University (Science Information Processing Centre) as of 1975. It is applied in the teaching of physics. In 1979, 360 pupils took the course at the rate of 50 hours a year (2 hours a week). The hardware used was a TOSBAC 40 minicomputer with 48 terminals in the form of boxes with push-buttons for answering multiple-choice questions. The computer checks progress by those pupils using lesson sheets.

N.B. The information on these two projects dates from 1979 and is therefore subject to verification.

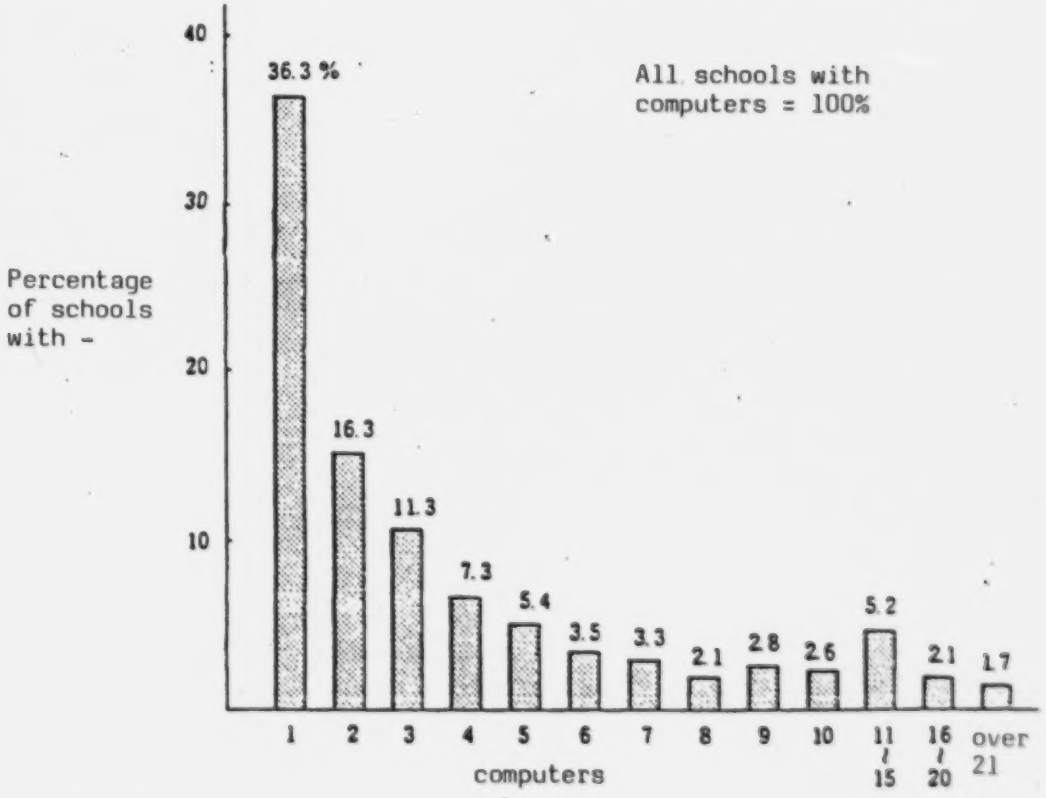
SECOND CYCLE SECONDARY EDUCATION

Hardware

No. of schools equipped: 2370

Percentage of total: 45.6% (average)
public schools: 49.8% with an average of 3.9 machines per school
private schools: 32.2% with an average of 4.8 machines per school.
7.5% of public schools and 13.9% of private schools have over 10 microcomputers each.
Another source gives an average figure of 65.38% for schools equipped, with an average of 4.20 machines per school (see tables on pages 158 and 159). The same source says that there were 8 000 computers (7 000 microcomputers and 1 000 minicomputers) in secondary schools in 1982.

Computer density at upper secondary schools



(Source: Country Report of Japan - 1984)

Financing

Hardware costs are partly met by the Education Ministry but an initial contribution is required of the local school administration boards. Some teachers buy microcomputers out of their own pockets.

Total hardware costs: 122.5 million Yen (subject to confirmation).

Networks

Star configuration networks for educational management purposes using telephone lines exist (see below), linking computers at university research centres and school microcomputers.

Types of application

Computer assisted instruction

Teaching of scientific basics (mathematics, physics, chemistry etc.). Applications are mainly in use in technical and commercial schools with practically no penetration in general education (see Specialised training establishments below).

Teaching of informatics

This is part of technical and commercial training programmes and has various forms: Information sciences, Information processing, Industrial mathematics, Management and automation, etc. Course content is decided by the Ministry of Education and is as follows:

Content of Subjects related to Information processing in the course of study for upper secondary schools

INFORMATION TECHNOLOGY I

1. Objectives

Understanding of the fundamentals of technology concerning computer programming and the development of ability in practical application.

2. Content

(1) Fundamentals of programming
(2) Complex programs
(3) File processing
(4) Operating systems

INFORMATION TECHNOLOGY II

1. Objectives

Understanding of the fundamentals of computer-related technology, telecommunications and control and the development of ability in practical application.

2. Content

(1) Fundamentals of computer technology
(2) Fundamentals of data communication
(3) Fundamentals of control technology
(4) Conservation technologies

INFORMATION TECHNOLOGY III

1. Objectives

Acquisition of basic knowledge and technology concerned with program design and the ability to apply this skill to software development.

2. Content

(1) Program design techniques
(2) Debugging techniques
(3) Outlines of software

SYSTEMS TECHNOLOGY

1. Objectives

Understanding of the fundamentals of technology concerning systems and the development of ability in practical application.

2. Content

(1) Structures of systens
(2) Systems analysis
(3) Systems design
(4) Models and simulations

INFORMATION PROCESSING I

1. Objectives

Understanding of computers and their uses as well as the development of basic information processing abilities through practical training on computers.

2. Content

(1) Contemporary society and computers
(2) Functions and composition of computers
(3) Data processing
(4) Fundamentals of programming

INFORMATION PROCESSING II

1. Objectives

Acquisition of technology concerned with programming and systems design through practical training on computers as well as the development of basic ability in processing management information with regard to enterprises.

2. Content

(1) Enterprise management and information processing
(2) Programming of data processing
(3) Systems design of data processing
(4) Management information processing

(Source: Information processing studies in Japan - 1985)

Educational management

Centres of research on computerised educational management systems:
- Curriculum development research centre (CRDC), Gifu University.
- Research and training centre, Kyoto university for education science.
- Centre for educational technology, Nagasaki University.

Educational management systems were orginally developed on minicomputers. Some of the programs have been transferred to microcomputer for use in schools. The hardware at the research centre is used as host computer and the microcomputers in the schools as terminals.

The information processed (educational objectives, results of tests, elements of courses, etc.) is stored in the mainframe computer but some may be transferred to schools for local use if desired. Communication between host and terminals is by telephone line or by diskette exchange.

The SIS-TEM (Study of Instructional System for Teaching, Evaluation and Management) system set up by Gifu University in 1971 was initially intended to enable curricula and other educational activities to be sub-divided in the best possible way on the basis of feedback from pupils. Developments have made the automatic generation of elements of CAI courses possible, particularly in physics.

Under the Compter-assisted self-instruction system for teachers (CASIST) project the Kyoto University of educational science has developed a number of sub-systems including an Instructional resource management system (IMRS) and an analysing program package for educational research (APPER) for the diagnosis of learning difficulties and the management of instructional sequences. MINI-APPER, the version for microcomputers operates in the conversational mode in Japanese and is sold to schools. It is used at the Minakuchi high school, for example, in the Shiga prefecture. The programming language used is similar to Lisp.

Some other isolated developments in this sector are:

- The monitoring of pupils' performance at Koyomadai high school, Tokyo. After being used for a CAI physics course since 1974, the TOSBAC 40 L minicomputer has also, since 1981, been operating an educational management system.
- Time table management at Kyoto Industrial University, South Yokohama High School.

Administrative management

There are some applications for the management of applications for entrance, enrolment figures, attendance records, accounts and equipment management.

- In the Hiroshima prefecture a research team on timetable management is working on the development of programs for microcomputers (SECTA - system for effective class teacher arrangement).
- The Education Committee of Aichi prefecture and Heio University also have similar microcomputer-based management systems.

Software - languages

A standard CAI language was developed in the early 70s and influenced the subsequent development of CAI. Since microcomputers made their appearance the main languages used are Basic and APL.

A pilot project at the Centre for Educational Research and Training of Kyoto University of Science and Education has developed a derivative of Basic - Prebas (Pretty basic) - as a standard programming language for its correspondents. Microcomputers in the schools in this network have an interpreter which translates Prebas into their own versions of Basic.

Software - distribution

This is mainly carried out by two teacher associations:

- Japan Society for Research in Information Science Instruction (for technical schools), and
- Japan Society for Research in Information Processing Instruction (for commercial schools).

Teachers

Generally speaking, teacher training is provided by the colleges and universities. Primary and first cycle secondary teachers graduate after two years higher education and second cycle secondary teachers after 4 years. The teaching of computer science being the responsibility of the industrial and commercial schools, teachers of computer science have to have certificates of education from one or the other.

Since, however, the universities are unable to provide for the production of qualified computer science teachers en masse, the authorities decided to encourage teachers to take in-service training in the form of a "training course for teachers in charge of information processing studies".

- In-service training

The further training programme for teachers began in 1970 when two centres were opened in Tokyo and Osaka. As of 1974, the Regional Centres (see Special contexts section) gradually took over teacher training. Training sessions are organised at the beginning and end of summer each year (July and October) for industrial and commercial school teachers. The courses run for 2-3 months. Between 1970 and 1983 a total of 909 teachers were trained but whereas, in the early years, an average of 100 teachers attended the courses each year the figure has fallen more recently to about 60.

- Initial training

An Educational Technology course is offered for trainee teachers at the Gakugei University in Tokyo. The computer science option includes courses in information science, and educational and educational management applications. The course lasts one year.

Computers in Japanese upper secondary schools

Number of computers	All schools Number	All schools Ratio (%)	Public schools Number	Public schools Ratio (%)	Private schools Number	Private schools Ratio (%)
1	930	41.7	744	40.4	186	47.7
2	353	15.8	300	16.3	53	13.6
3	242	10.8	127	11.8	25	6.4
4- 5	227	10.2	193	10.5	34	8.7
6- 7	155	6.9	138	7.5	17	4.4
8-10	131	5.9	110	6.0	21	5.4
11-20	131	5.9	98	5.3	33	8.5
Over 20	62	2.8	14	2.2	21	5.4
Total	2 231	100.0	1 841	100.0	390	100.0

(Source: CMI in Japanese secondary schools - Unesco 1984)

PARTICULAR CONTEXTS

Information processing study centres

Information processing study centres have been set up in some of the country's 47 prefectures. Public grants have enabled 36 such centres to be equipped on top of which there are the two centres financed out of the local funds of two other prefectures. They serve the schools in their area, particularly the technical and comercial schools whose pupils and teachers have free access to the facilities offered.

The range of applications covers documentation management, the processing of educational data (pupil performance monitoring, diagnosis of

PARTICULAR CONTEXTS

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The range of applications covers documentation management, the processing of educational data (pupil performance monitoring, diagnosis of learning difficulties, school medicine, questionnaires, educational research, etc.), administrative management and the further training of teachers. This latter resource includes the learning of Fortran (as a suitable language for scientific and technical subjects) and its applications (long courses) and an introductory course on Basic and the use of microcomputers (short courses). Equipping these centres has cost about 115 million Yen (500 000 dollars).

The table below summarises the computer applications available at the different regional centres.

Computerised documentation applications

- The Hiroshima University Library, access to the INSPEC and BIOSIS databases on a HITAC 8700 mainframe computer. The system is called HUNDRED = Hiroshima University new document retrieval and dissemination.

- The Aichi prefecture's educational centre, AIDOR system (Aichi in-line document retrieval) set up in 1975. The system runs a database containing the centre's educational documents.

- The Tsukuba scientific information processing centre set up an on-line retrieval service in 1976 on an ERIC computer which in 1981 was named UTOPIA (University of Tsukuba online processing of information) operating inside the university but also accessible from outside by network.

Use of computers in local education centres and research institutes - 1982

Pref. and Des. City	Model	Memory capacity	a	b	c	d	e	f
Aichi	ACOS-550	8M		x	x	x	x	
Hokkaido	ACOS-550	6M	x	x		x		
Fukushima	FACOM-M160F	6M	x			x		
Fukuoka	HITAC-M180 III	6M	x	x	x	x	x	x
Oita	ACOS-450	6M	x	x	x	x	x	
Kumamoto	FACOM-	5M	x			x		
Hiroshima	ACOS-350	4M	x		x	x		
Saga	MELCOM-700 III	4M	x	x		x		
Miyagi	FACOM-M150F	3M	x			x		
Shiga	FACOM-M160S	2.5M	x	x		x		
Osaka	FACOM-M150F	2M		x		x	x	x
Sapporo	ACOS-250	1.5M		x	x	x		x
Iwate	NEAS 2200	48K	x	x		x	x	
Sunma	FACOM 230-28	64K	x	x		x	x	x
Toyama	FACOM 230-25	128K	x	x	x		x	x
Ishikawa	FACOM 230-28	48K	x	x			x	x
Fukui	FACOM 230-25	48K	x			x	x	
Tottori	FACOM 230-25	48K	x			x		x
Tokushima	FACOM 230-25	32K	x			x	x	

Notes:
a = used for students' practical training
b = used for services for instruction and office work at schools
c = reference of books, documents and printed materials
d = used for in-service training of teachers and other education-related personnel
e = used for data processing for educational administration
f = used for office work management at the centres or research institutes

(Source: NIER occasional paper, March 1984)

SPECIALISED TRAINING ESTABLISHMENTS

An estimate by the Association of specialised industrial training establishments puts the number of students receiving computer training there at 30-40 000. These schools train some two-thirds of the students passing the second category information processing technician's examination.

Information processing technician' examination

The two tables below give the success rates in the three parts of the information processing technician's examination in 1981 and a breakdown by type of job taken up by students successful in that year.

Number of students sitting and number passing the Information processing technician's examinations in 1981

Category of Information processing technician's examination	Number of candidates	Number successful	Success rate (%)
Special category	3 877	422	11.4
First category	11 440	1 327	11.6
Second category	25 445	5 089	20.0

Occupations of successful candidates at 1981 Information processing technician's examination

Occupation sector	Special category		First category		Second category		Total	
	Number	%	Number	%	Number	%	Number	%
Electronic computer manufacturing and sales business	204	46.1	232	17.5	367	7.2	803	11.7
Software business	58	13.1	363	27.4	1 390	27.4	1 811	26.4
Calculation centres, etc.	81	18.3	273	20.6	871	17.1	1 225	17.9
General business firms and associations	90	20.4	232	17.5	831	16.3	1 153	16.8
Public agencies	4	0.9	14	1.0	102	2.0	120	1.8
Schools and research institutes	2	0.5	23	1.7	73	1.4	98	1.4
Private enterprises	0	0.0	0	0.0	2	0.0	2	0.0
Students	2	0.5	181	13.6	1 416	27.9	1 599	23.3
Other	1	0.2	9	0.7	37	0.7	47	0.7
Total	442	100.0	1 327	100.0	5 089	100.0	6 858	100.0

(Source: Information processing studies in Japan, 1985)

The examination was instituted by the Ministry of International Trade and Industry (MITI) in 1970, the purpose being to train systems engineers, senior programmers and general programmers (primarily with job training in mind) as shown in the following table:

Examination category and the corresponding knowledge and skills to be possessed by the candidate

Examination category	Target of the examination	Standard
Special category	Systems engineer (engaged in the analysis and planning of information processing systems)	Person with more than 3 years practical experience, possessing the knowledge and skills necessary for the planning of information processing systems.
First category	Senior programmer	Person with over 3 years of programming experience, possessing the knowledge and skills necessary for programming and the preparation of advanced programs.
Second category	General programmer	Person with over 1 year's programming experience, possessing the knowledge and skills necessary for the preparation of programs.

(Source: Information processing studies in Japan, 1985)

Organisation of the teaching of informatics in specialised training schools

Most specialised training etablishments offer both one and two-year courses on information processing. The short courses (one year) produce technicians with some knowledge of the rudiments of programming and the longer courses (2 years) are designed to give the sound theoretical grounding and technical skills required of senior technicians.

To the extent that specialised training establishments are expected to train specialists of a level at least equal to that of graduates from the conventional universities but in a shorter space of time, it is not unusual for computer science courses to fill 1 200 hours a year with more, or less, importance attached to hardware or software depending on the department involved.

HIGHER EDUCATION

Arrangements in the universities with regard to computer science come under the following headings.

- Promotion of computer science in general education (familiarisation with its principles, applications and hardware).
- Vocational training in information processing (primarily for the training of hardware and software specialists and research scientists).
- Research on the use of computers in education (the accent being on pluri-disciplinary research).
- Teacher training (further training of teachers and research students in higher education and responsibility for initial and further training of secondary teachers).

Promotion of computer science in general education

Measures under this heading include the setting up in universities of an Information processing study centre open to all departments in the university and to teachers and students alike. In principle the centres are reserved for familiarisation or general computer training activities for teachers who do not intend to specialise in information processing.

The first of the centres was set up at Tokyo University in 1972. Now there are centres at nine more making a total of ten for the country: Hokkaido University, Muroran University of Engineering, Tokoku University, Nagoya University, Nagoya University of Engineering, Kyoto University, Osaka University, Kyushu University and Kyushu University of Engineering.

Two examples of centres

- Tokoku University centre

Set up in 1982 for the benefit of undergraduates, the centre has a mainframe computer with 24 terminals and four sub-centres in the engineering, science, agriculture and pharmacy faculties with, respectively, 36, 23, 12 and 6 terminals.

Information processing instruction as part of general education had begun in 1980, 2 years before the centre was set up, when students used the equipment for the third and fourth year specialist courses in information processing.

The general course, called Information processing study support system, consists of a series of lectures and practical work occupying 90 minutes per week over 15 weeks. 2 100 students took the course between 1980 and 1982.

When the centre was set up in 1982 two courses were initiated for students on the arts side and 14 for those in the science faculties and these were taken by 1 700 students that year.

In 1983 the number of courses for arts students was increased to six and those for science students to 15. These were taken by about 2 000 students, i.e. 90 per cent of undergraduates.

- Tsukuba University centre

Ever since the Tsukuba pilot University was opened in 1974, general computer training has been compulsory for all first cycle students in all subjects. They have to sit an examination at the end of the 10-week course which consists of three 75-minute periods a week (lecture + seminar + practical work).

The purpose of the lectures is to make students aware of computer applications and their social impact and the purpose of the seminars and practical work is to enable students to master the use of the computer in their future occupations.

Two instructors work in alternation and the classes are 40-50 students at a time. The main skills taught are the mastery of Fortran, the handling of terminals, word processing and the use of programs. Some of the lessons are given by means of CAI modules called MILESTONE (Microcomputer video and laser videodisc based stand-alone on-line).

This instructional system developed by the university is based on a hardware configuration in which a computer terminal is used in conjunction with a videodisc reader. 45 terminals of this type are installed in the university, 27 of them in the practical room, and students work in pairs at each terminal. Since 1983 the CRT screens have been replaced by microcomputers and the learning of Basic has been introduced.

The terminals are free of access to students from 9 a.m. to 10 p.m.

The number of students trained in this way between 1974 and 1984 is 13 000.

EXTRA-MURAL

Some computer training takes place outside the formal education system, mainly in the form of courses offered by computer manufacturers or distributors to their customers and those that computer-using firms provide for their staff.

In the former case the courses, subsidised by the firms concerned, are of a considerable variety, their average duration being 30 weeks in the year. Their purpose generally is to enable users to learn about, or perfect their knowledge of, specific computers. In the latter case, university facilities being quantitatively inadequate to meet the country's skilled manpower requirements, public and private firms train their own staff. Most qualified computer workers in Japanese firms have been trained within their companies. Generally speaking, Japanese employers consider that the levels of training offered by the universities do not meet their needs and prefer to assume responsibility for the training of their specialists on the hardware they have. This attitude on the part of the business world towards the training given at school and in university explains why the computer literacy concept has not gained much ground in Japan.

EVALUATION

There is no overall evaluation, only isolated examples of the assessment of projects and software.

FUTURE DEVELOPMENTS

Subject to a reorganisation of curricula and the content of teacher training courses and the solving of the problems concerning the Japanese alphabet, CAI may be expected to make gradual - though very patchy and unconcerted - progress in the public education system. Because of its independence, the private education system will no doubt be more permeable to the rapid growth of applications.

It would seem, indeed, that Japan's hesitation about introducing computers in its eductional system is slowly dissolving, given the urgent need to train teachers properly, which would seem to be borne out by the Ministry of Education's publication of a Standard Curriculum Guide for Training in the Educational Usage of Microcomputers in 1984. The manual is designed for administrative bodies, education institutes, research teams, etc. in both formal and informal education. It suggests there should be three levels of training (basic, intermediate and advanced) lasting 2 1/2, 5 and 8 days respectively.

A survey carried out late in 1982 in the Aichi prefecture on the expectations of schools as regards computers - the findings of which could, it would seem, be extrapolated to the rest of the country - shows that 27 per cent of first cycle secondary, 15 per cent of second cycle secondary and 8 per cent of primary schools would like to be equipped by 1985. At the national level, 80 per cent of second cycle secondary, 30 per cent of first cycle secondary and 9 per cent of elementary schools could well be equipped by that date.

Co-operation between the private sector and research institutes and the development of authoring systems or software needing no programming should help the development of courseware. Based on the findings from artificial intelligence research and knowledge engineering, the latter should provide a solution to the problem of the Japanese alphabet.

Sources:
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K E N Y A

Basic data

Total school population: 4 610 860 (1981)

Education budget: 4 307 060 000 Shillings (1982)
as percentage of GNP: 6.5%

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	4 120 145 (1982)	115 042
Secondary	477 317 (1981)	17 809
Tertiary	13 398	

No. of computers in use in education

Thirty educational establishments are equipped with microcomputers. With the exception of seven university departments and two polytechnic institutes they are all private establishments. The total number of computers in school establishments at all levels is 162.

Establishments with computers

Preparatory schools/kindergartens	6*
Secondary schools	12
Polytechnic/teacher training colleges	2
University departments	11
Total	31

* Three of these institutions are under their corresponding secondary schools so that no information is available.

Source: Scott (1984)

Types of computer and distribution

	Primary	Secondary	Higher	Total
Sinclair ZX81	2	13	-	15
Sinclair Spectrum	6	8	1	15
Apple IIe	-	55	4	59
BBC B	-	13	-	13
Rair Black Box	-	-	2	2
Commodore	-	-	11	11
Commodore Vic	-	-	1	1
Nascom 2	-	-	20	20
Transam Tuscan	-	-	6	6
Comart Communicator	-	-	1	1
Kaypro	-	2	14	16
Wang	-	-	3	3
Total	8	91	63	162

Source: Scott (1984)

Computerisation policy

No national policy has yet been formulated but a committee, meeting under the auspices of the National Council for Science and Technology which comes under the Ministry of Education, Science and Technology, is currently framing such a policy. The teaching of computer science and its applications has so far been left to the initiative of the educational establishments themselves and in view of their heterogeneity it would seem important for a national policy to be defined in order to coordinate the measures that are taken.

General background

A report published in 1982 by the Institute of Computer Science gives the number of mainframe computers in Kenya as 180 (public and private sectors). The report forecasts that the number will be 300 in 1985 and over 1000 in 1990. The most common makes are COMPRITE, IBM, ICL, NCR and WANG and most are multi-station computers with terminals with screens.

Since 1980, in spite of the very heavy import duty (often tripling the price), the number of microcomputers (home computers, word processors, office machines and educational hardware) has been increasing steeply. Prices range from 2 500 Kshs for a home computer to 400 000 Kshs for office computers. The most popular of the twenty or so makes on the Kenyan market are Sinclair, Commodore, BBC, Apple, Wangwriter, Comart, Osborne, Kaypro, Epson, Wang, IBM, ICL, Decisionmate V and Olivetti M20.

The same 1982 report (see above) states that in 1981 there were 2018 computer and electronics-related jobs. The demand for qualified manpower is considerable as is the need for in-service training. Problems are the drain of qualified staff into the private sector which pays more and the difficulty (without international or bilateral assistance) of attracting and retaining foreign specialists. Another difficulty is the inadequacy of the maintenance services and their poor reliability.

PRIMARY EDUCATION

Hardware

At the primary level, 3 schools (all private) have a total of 8 microcomputers (Sinclair Spectrum and Sinclair XZ81), financed from the schools' own resources and donations. Operating and maintenance costs are met by the establishments themselves.

Software

The software used (written in Basic) is all imported and mainly consists of CAI (reading and arithmetic) and games programs used to develop computer literacy.

A survey of the schools having computers shows that the main difficulties encountered in the use of computers are:

- The cost of hardware and software.
- The difficulty of finding suitable programs for the very young.
- The unreliability of the supply and its interference with computer operation.

SECONDARY EDUCATION

Hardware

At the secondary level, 12 establishments are equipped with a total of 89 microcomputers with the following distribution:

Name of Institution	Level	Microcomputers	
		Model	Number
Aga Khan Academy	Sec.	Apple IIe	4
		BBC-B	2
Starehe Boys Centre	"	Apple IIe	21
		BBC-B	8
		Sinclair Spectrum	8
Nairobi Academy	"	BBC-B	1
		Sinclair ZX81	13
Hillcrest Secondary	"	Apple IIe	6
Rosslyn Academy	"	Apple IIe	3
International School of Kenya	"	Apple IIe	15
Imani School Thika	"	Apple IIe	1 + 5*
Mount Kenya Academy, Nyeri	"	Kaypro	2
St. Patrick's School, Nyeri	"		
Banda School	"		
St. Mary's School	"		
Braeburn School	"		

* On order

Source: Scott, 1984.

Hardware costs are met by the schools themselves in six cases, from grants made by aid organisations in four cases including the two experimental projects described below, and by donation in one other case. Maintenance and operating costs - except for the two pilot projects - are met by the schools themselves.

In addition, IBM announced in 1984 that it would equip five schools that will be introducing computer science courses. Two teachers from Kenya Polytechnic have left for Madrid to train for this purpose.

Software

All software and languages are imported. The most frequently used language is Basic, followed by Logo, then Pascal, Lisp, Fortran and Pilot. The CAI programs relate to all subjects. In some establishments microcomputers are mainly used to develop computer literacy and as a club activity.

A survey of secondary schools with computers has shown that the problems they encounter in introducing informatics are these:

- The high cost of hardware.
- Software evaluation and the lack of locally produced software.
- The absence of a definition of what a computer science curriculum should be.

PILOT PROJECT No. 1

Starehe Boys Centre

This is a school for disadvantaged children under the supervision of the Ministry of Culture and Social Affairs. The project started in 1980 on the prompting of an Australian volunteer worker who defined an experimental "Computer Training Scheme".

Hardware

37 microcomputers (BBC, Apple and Spectrum).

Objectives

The general objective of the project is twofold:

- Firstly to give all pupils in the school a sound knowledge of computers and computer applications so that they are able to handle these in their working life.

- Secondly to give selected older pupils sufficient training for them to find work in the local informatics industry when they leave school.

The other objectives are to familiarise teachers with computer science in order to encourage them to use computers in their own subjects and to explore the possibilities of CAI, computer games, etc.

More generally, it is hoped that the experiment will help to identify the answers that the computer could bring to the educational requirements of the developing countries and to define the minimum computer skills children in secondary education need to be given with the ultimate objective of having computer science taught throughout the country at this level.

Results

In spite of the success of the project with the schoolchildren (even though the computers are accessible only between and after classes) important problems have arisen since the project was launched:

- Difficulties in getting teachers to be prepared to use of the machines and software.

- Problems of training junior and supervisory computer room staff.

- Lack of reliability of certain hardware.

- Problems due to the absence of government policy in the informatics field and the lack of methodological assistance.

- Difficulties related to the lack of co-ordination of teaching activities in the school and the absence of any definition of the role played by computer activities.

- The problem of replacing the project leader who is due to leave after a six-year stay, the school's own funds not being enough to recruit locally.

In spite of these many difficulties, the project enabled six schoolchildren to be trained in 1980 and eight in 1981 who all found work in the industry on leaving school.

PILOT PROJECT No. 2

Aga Khan Academy

This project - the Aga Khan Silver Jubilee Pilot Project "Computers in Education", was launched in 1982. It is a research project on the cost-effectiveness of informatics for education in the third world. The project is financed by a number of agencies under the responsibility of the Aga Khan Foundation.

Objectives

The objectives set for the project are:

- To produce the information needed by agencies active in the developing countries with regard to computers in the educational field.

- To design a package (hardware, software and accompanying material) for computer beginners.

- To distribute the results of research on the impact of this educational package in pilot schools.

Hardware

The establishment is equipped with 9 Apple II and BBC-B microcomputers supplied by external assistance.

Results

The main problem encountered in this project is the high level of import duty on hardware which prevented the envisaged extension of the supply of computers. The success of the project is measured in terms of the fact that the computer is now regarded by both pupils and teachers as a useful educational aid.

The machines are used on average 50 hours a week (including weekends) by the 700 children in the establishment.

SECONDARY EDUCATION/TEACHER TRAINING

The training of teachers is done by the computer-equipped schools themselves. One teacher training establishment however, the Kenyatta University College, has recently had microcomputers fitted in several departments. In addition, some graduates of the Institute of Computer Science can qualify for fellowships for the training of instructors (one year full time) at Mombasa Polytechnic (which, incidentally, has just acquired a computer installation) and the Kenya Technical Teachers College.

HIGHER EDUCATION

Hardware

At the higher education level, 15 establishments are equipped with a total of 57 microcomputers, the distribution of which is shown on the table on the following page.

At this level where all the establishments are public (unlike the primary and secondary where computer-equipped schools are all private) the funds for hardware come mostly from foreign aid (assistance agencies). Operating and maintenance costs are met by the establishments themselves.

Software

Software and languages are almost all imported. The most commonly used language is Basic, followed by Pascal, Fortran and Cobol and then Logo and Lisp. Programs used are word processing, database management and graphic programs.

Results

Higher education establishments that have introduced informatics identify the following problems:

- The high cost of hardware and software.
- The high cost of maintenance.
- The absence of government finance for purchasing equipment.
- The training of secretarial staff responsible for data input.

In general, establishments regret having to depend entirely on foreign aid in this field and receiving no funds for the purchase or the operation of equipment from the responsible ministry.

Distribution of computers in higher education

Name of Institution	Level	Microcomputers	
		Model	Number
Kenya Polytechnic	Higher	Rair Black Box	2
		Commodore	10
Kenya Technical Teachers College	Higher	Kaypro 4	12
		Kaypro 10	2
University of Nairobi	Higher		
Department of Physics		Nascom 2	10
		Transam Tuscan	2
Dept of Electrical Engineering		Nascom 2	10
		Transam Tuscan	3
		Commodore	1
Institute of Computer Science		Transam Tuscan	1
		Wangwriter	1
		Sinclair Sprectrum	1
Dept. of Agricultural Economics		Apple IIe	2
Dept. of Food Science and Technology		Wang	2
Dept. of Animal Physiology		Apple	1
Kenyatta University College	Higher		
Department of Mathematics		Comart Communicator	1
Department of Physics		Sinclair Spectrum	10
		Commodore Vic	1
Bureau of Education Research		Apple IIe	1
Appropriate Technology Centre		Sinclair Spectrum	2
Egerton College, Njoro	Higher	Wang	1
United States University, Africa	Higher	Wang	1

Source: Scott (1984).

COMPUTER TRAINING

This is largely given by the computer companies; ICL and NCR have set up two permanently staffed regional training centres, the courses costing from 100 to 500 Kshs a day.

Several private establishments offer courses for computer programmers and operators, generally part-time, lasting up to 3 months and costing anything from 1 000 to 4 000 Kshs each.

The high cost limits access to such courses to those whose training is paid for by their employers.

Another point is that several private training establishments give courses that are not tailored to the real industrial needs of the country.

Future developments

The intention is to introduce the basic systems analysis training package developed by the National Computer Centre in the United Kingdom. The advantage of this course is that the examination at the end of it can be held and administered locally whereas hardly any of the local courses lead up to diplomas carrying industrial credibility.

It would also seem important and urgent to standardise diplomas, including those awarded in public education, and harmonise the training offered so as to meet national industrial needs in the most efficient way possible.

ADMINISTRATIVE MANAGEMENT APPLICATIONS

The Kenya National Examinations Council was computer-equipped in 1980 and since that date the administration of examinations (primary through higher education) has been computerised.

In 1984 a University of Nairobi graduate (second cycle) developed a forward budgeting project that uses modelling techniques.

FURTHER NOTES

Kenyan establishments largely depend on external assistance for developing their computer projects. Requests for aid in 1984 came under the following headings:

Institute of Computer Science (University of Nairobi)

- Request to the British Government for assistance in the supply of supplementary equipment (including over 100 microcomputers) and library management systems.

- EEC aid for word processing equipment for the School of Journalism.

- UNDP aid in the setting up of a training programme on applied informatics.

- Unesco aid for training scholarships (now in progress) and supplementary equipment for the Faculty of Science.

Departments of Physics and Electrical Engineering (University of Nairobi)

- Inter-University cooperation programme with the United Kingdom (hardware, personnel exchanges, technical assistance).

Government bodies (President's Office, Ministries of Finance, Transport and Communications, and Industry) have likewise built up their computer facilities or enjoy technical assistance in the framework of bilateral or international cooperation agreements.

Source:

- Scott (Pr. R.J.P.). Development of computer sciences and applications and informatics in education. A survey of East Africa. Nov. 1984.

K O R E A

Basic data

Total school population: 10 999 058

Education budget: 2 275 267 million Won
as percentage of GNP: 4.63%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I / II / III / IV
Cycle	Primary / Interm. / Secondary
	Pre-comp. / Compulsory / Post-compulsory
	Commerce schools. Misc. civic studies
	Sec. schools Commerce Misc.
	Teacher train.
	Vocational
	University
	Colleges
	Post-grad. studies

	School population per level	Number of teachers per level
Primary	5 040 958 (1984)	126 232 (1984)
Secondary	4 828 026 (")	132 649 (")
Tertiary	1 130 047 (")	31 786 (")

Informatics policy

The government has been supporting the development of informatics in the country which is treated as a major policy goal. In July 1970 the Head of the State decided that informatics would be introduced in second cycle secondary and higher education and, in conjunction with other governemnt bodies, the Ministry of Education defined an "Informatics Plan" reflecting the political will to develop informatics in education.

Since then, the teaching of informatics has been introduced in commercial schools and technical education establishments.

At the present time, the teaching of computer science, by decision of the Ministry of Education in 1983, runs right the way through from primary level to university.

PRIMARY AND SECONDARY EDUCATION

Educational policy for encouraging the introduction of informatics in education at these two levels resulted in their being equipped with hardware and software and the publication, by the ministry responsible, of school manuals in 1984.

The objectives of the teaching at these two levels are to familiarise schoolchildren with data processing and to give them a basic, general understanding of informatics.

The supply of computers is to be accompanied by the definition of the related curricula and the issue of the necessary manuals (including what is needed by the commercial schools and the technical education establishments). For commercial and technical education informatics has already been part of the programme since 1970, compulsory in some cases and optional in others.

Software

In some disciplines the development of CAI and educational management programs is also envisaged. In 1983, the Korean Educational Development Institute (KEDI) launched the production of 15 experimental programs for different educational approaches (drill and practice, simulation, games, etc.) by teams made up of content specialists, educationalists and programmers. After evaluation of the programs produced, the KEDI's intention is to have larger scale production and to distribute the courseware to schools.

TEACHER TRAINING

The first teacher training schemes were launched during the summer holiday these last few years and were for primary and secondary teachers. At the moment, the provincial educational administrations provide training in informatics for practising primary and secondary teachers. A plan for the initial and further training of teachers is currently being defined at the Ministry of Education with the collaboration of the National Institute for Research in Education, the Education Council and the Data Processing Centre for Teachers.

Sources:

- Final Report of the third Asian seminar on educational technology in Tokyo, 26 Sep/2 Oct 1984, APEID 1984.
- Report of Mission to Indonesia and Singapore (20-25 Oct 1983) by M.C. Pant (ACEID).

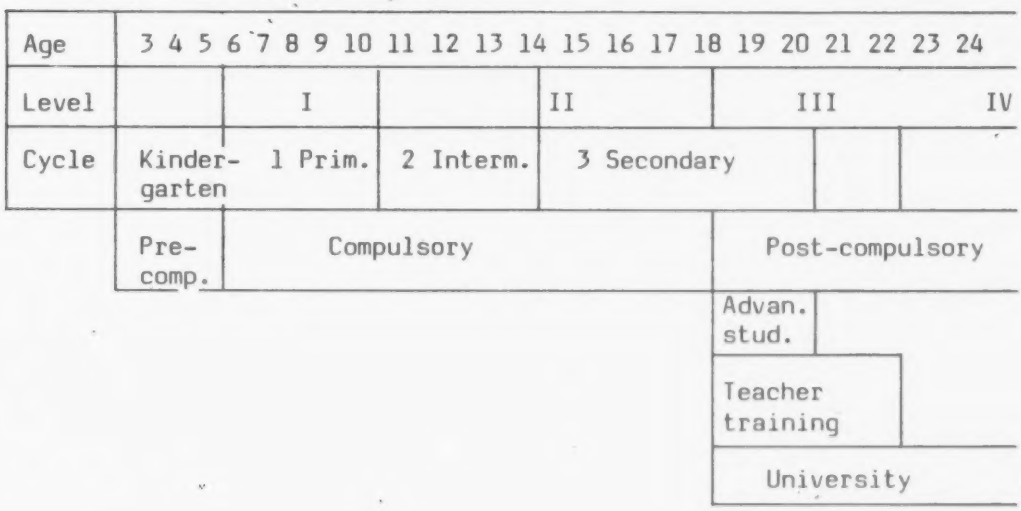
K U W A I T

Basic data

Total school population: 387 689 (1982)

Education budget: 316 223 000 Dinars (1982)
as percentage of GNP: 4.2%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	160 188 (1982)	8 346 (1982)
Secondary	209 952 (")	17 155 (")
Tertiary	17 909 (")	1 355 (")

APPLICATIONS

There was a pilot project for the introduction of informatics in school curricula, initiated by a lycée that equipped itself with a number of microcomputers with the aid of the parents' association in order to develop computer utilisations outside school hours.

As a result of the experiment the government decided to give computers to four lycées for a trial of computer science teaching to schoolchildren and teachers. In 1985 a teaching manual was brought out for this educational module representing a total of 5 hours of lessons a week over a period of fifteen weeks (the programmes are in Arabic).

Research

The Kuwait Institute for Scientific Research is conducting research on the production of terminals.

Source:

- Introduction of informatics in the educational system of the Arab world. Regional office for education in Arab countries, Unesco, Nov. 1985.

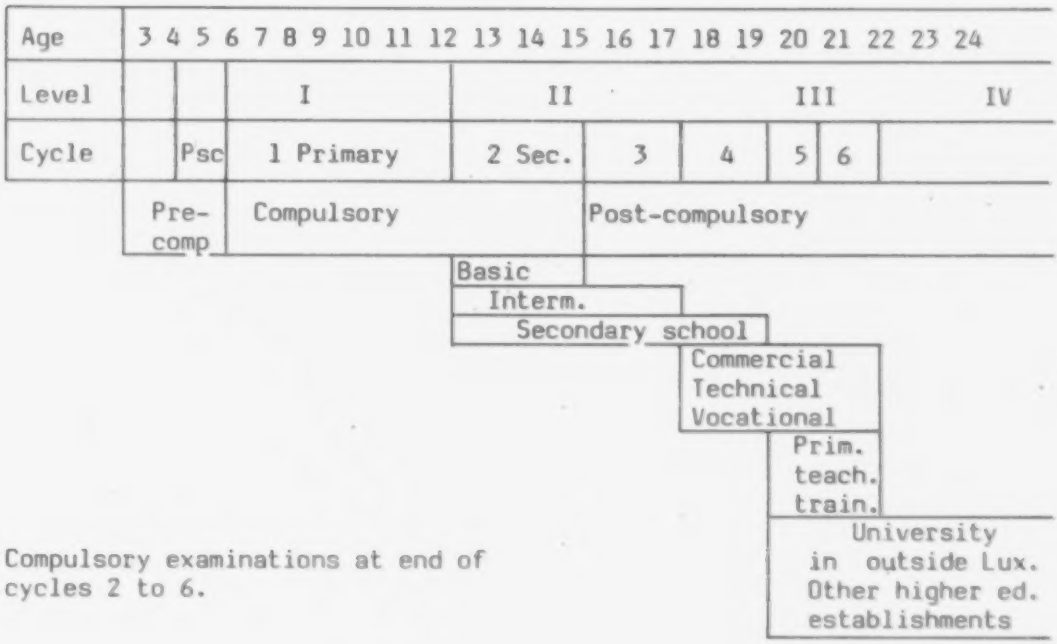
L U X E M B O U R G

Basic data

Total school population: 47 900 approx. (1982)

Education budget: 10 822 300 000 Francs (1981)
as percentage of GNP: 6%

Structure of education:



Compulsory examinations at end of cycles 2 to 6.

	School population per level	Number of teachers per level
Primary	22 826 (1982)	1 685
Secondary	24 341	2 020
Tertiary	699 (1981)	236 (1981)

Present situation

Efforts to introduce the new information technologies in education are concentrated on the institution of informatics courses at the secondary level, especially in the vocational schools. One of the reasons for the discrimination has been convenience: the introduction of a new course in the curriculum needs that curricular time to be freed for it and the recent reform of vocational education created the right opportunity for informatics. The situation remains difficult for the general schools where no similar large-scale reforms are planned for the moment.

Nothing has been done or is planned for primary schools.

A development plan has been drawn up by a consultative committee set up by the Ministry of Education with representatives of the Ministry, teachers and the private sector. By 1986, this three-year plan aims at equipping all secondary establishments (vocational and general) with a standard configuration of 16 stand-alone microcomputers installed in special rooms. The estimated budget is 60 billion Belgian Francs over the three fiscal years.

The PTT Ministry is testing the introduction of the LUXPAC network in Luxembourg. It could add a new dimension to the use of the new information technologies in education.

SECOND CYCLE SECONDARY EDUCATION

Hardware

Of the 25 establishments, 25 per cent have microcomputers mainly financed by the Ministry of Education but with some funds coming from the "Public buildings" department as first equipment appropriations.

VOCATIONAL TRAINING

Informatics courses take two hours a week for grade 11 and between two and four hours a week for grades 12 and 13, 36 weeks a year. Programming is taught only in grades 12 and 13.

Software

All existing software has been produced by teachers for their own courses. The number of programs is unknown.

Teachers

The only provisions made are for initial training of informatics teachers.

Source:

- Document CERI/NT/84.02 (OECD)

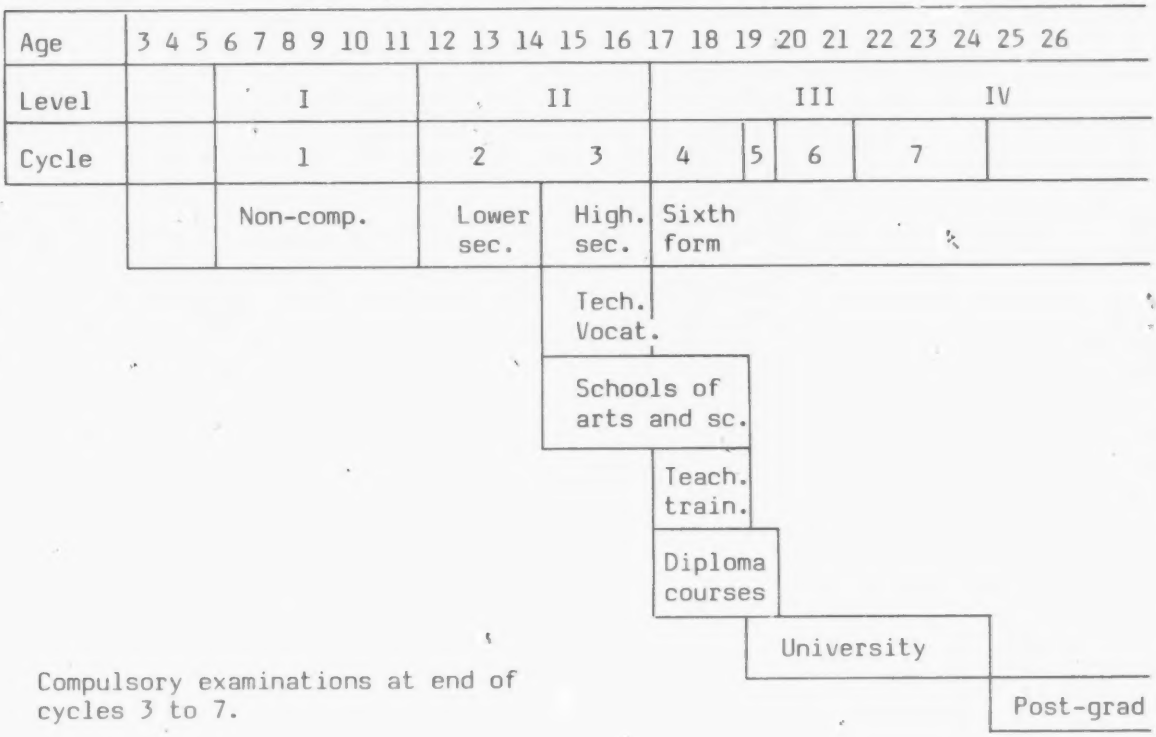
M A L A Y S I A

Basic data

Total school population: 3 360 000 approx.

Education budget: 4 409 491 000 Ringgits (1982)
as percentage of GNP: 7.6%

Structure of educational system:



Compulsory examinations at end of cycles 3 to 7.

	School population per level	Number of teachers per level
Primary	2 120 050 (1983)	81 664 (1975)
Secondary	1 173 202	54 787 (")
Tertiary	56 368	4 644 (")

General background

The uses of informatics in Malaysia relate more to the private than to the public sector, where the applications relate to such areas as public health, agriculture, financial and the budget. The number of computers in use in the country is increasing at a rate of about 25 per cent a year. Obstacles to growth in both hardware in use and applications are essentially financial. In the public sector other major impediments are the lack of qualified staff, data collection difficulties and software incompatibility.

Computerisation policy

Work is proceeding on the formulation of a national informatics policy which will lay down general objectives for computerisation in the public sector and priorities as regards applications.

A plan to introduce computer science in secondary education is to come into effect in 1986 when a pilot project will be launched. This is planned to continue into 1988; it will concern 280 establishments and be monitored by the Curriculum Development Centre.

Source:

- Final report of third Asian seminar on educational technology in Tokyo. 26 Sep/2 Oct 1984, APEID 1984.

M E X I C O

Basic data

Total school population: 21 183 566

Education budget: 306 522 900 000 Pesos (1982)
as percentage of GNP: 3.4%

Structure of educational system:

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Level	I										II						III				IV	
Cycle		Pre sch			1			2			3			4			5		6		7	
		Pre comp			Compulsory						Post-compulsory											

Secondary: 1st cy. | 2nd cy.

Techn. Industry Commerce Agricul. | Primary teacher training

Secondary teacher training

University Technical institute

Compulsory examinations at end of cycles 3 to 7.

	School population per level	Number of teachers per level
Primary	15 253 251 (1982)	418 982 (1982)
Secondary	4 817 198 (")	301 939 (1981)
Tertiary	1 013 117 (")	85 943 (1982

Policies behind the projects

In 1977 the Secretariat for the Plan and Budgets set up a Directorate-General for informatics policy with the task of defining requirements in both specialists and hardware and services at the national level. It is also responsible for establishing national standards for the purchase of hardware and for the design, development and installation of information systems.

In the educational sector responsibility for planning lies with the Secretariat for Public Education which defined a computer assisted instruction project in 1981 - see below.

Questions to do with the development of the information technologies also have a place in the 1984 medium-term "Education, culture and sports" programme which took stock of how far the country was behind the industrialised countries and recommended the generalised introduction of computers at primary and secondary level by the year 2000 and the substitution of imported hardware by domestically produced computers. A start was made by the National College of Education which brought out the first Mexican computers in 1984.

Currently there are 39 projects for the building of hardware in 17 institutes (including one for the development of a "Microcomputer system for education and development" - SIEMED).

The Secretariat for Public Education has also developed a microcomputer (Microsep) with the collaboration of the Autonomous University of Mexico.

PRIMARY AND SECONDARY EDUCATION

Practically speaking, informatics has not yet penetrated the public establishments at these levels. The Secretariat for Public Education has not yet authorised the introduction of courses or computer rooms and computer activities therefore take place only in the form of extra-mural work.

Yet the concern that informatics should be introduced at primary and secondary levels dates back to 1981 when the Vice Directorate-General for Educational Content and Methods was instructed to define a pilot research project on computer assisted instruction in primary education. The project began to be put into effect on an experimental basis in 1984 (training of staff and purchase of three microcomputers). Programs are being written in mathematics, Spanish and the natural and social sciences for the third year of the primary cycle. They will need to be validated before they are taken into general use, the hope being that this pilot project can be extended across the whole of the primary education sector or, failing that, be transposed into secondary education (see "Future developments" below).

In private education a recent survey indicates that 48 schools in 52 cities (29 in Mexico city alone) use computers (this does not include technical education establishments). All in all, it is reckoned that in private education, which accounts for eight per cent of the school population at primary and secondary levels, about 0.36 per cent of primary and 1.79 per cent of secondary schoolchildren have access to computers. In 85 per cent of cases pupils have a maximum of two hours computer work a week.

TECHNICAL EDUCATION

Informatics has hardly any presence in the public technical education establishments and is much better represented in private schools.

Training in informatics

The training of technicians in public establishments is, as far as technical education is concerned (second cycle secondary), provided by the Directorate General for technical and industrial education and the National College for Technical Vocational Training which together gave instruction to 2848 pupils in 1984.

HIGHER EDUCATION

Apart from the teaching of computer science itself a number of applications concern the teaching of other subjects at the higher level. The Technological Institute for Higher Studies at Monterey, for example, has developed a number of applications in the engineering sciences including the following;

- A system of examinations in statistics and dynamics.
- A centre for evaluating mathematics teaching.
- A system for generating case studies.
- A computer graphics system (technical design).
- A case simulation project (in industrial and systems engineering.

This Institute has a computer centre, a number of microcomputers and graphic palettes.

Software

In 80 per cent of the cases in which it is used, software is in English and does not meet the needs of Mexican curricula. Only a few schools, with money from foundations or foreign governments, have been able to produce special programs designed by the teachers and sometimes even by the students themselves.

Teachers

Most instructors in computer science have no teacher training. Instead, they are computer engineers and mathematics and electronics graduates. The mathematics teachers college of the State of Mexico recently decided to include the use of informatics in the training of teachers in this subject.

Research

Experimental research projects are under way on the following topics:

- The use of informatics in the education of children with hearing defects (research being carried out by the "Grupos Integrados Especificos para hypoacusticos" - GIEH).

- Experimentation in computer languages, computer rooms for young people, teaching how to programme, computer applications in special education (blind or deaf children) - research being conducted by the Autonomous University of Mexico.

- Computer applications in the teaching of mathematics, research on Logo and development of languages for teaching mathematics. This research is being done by the National Polytechnic Institute and its Department of Pedagogical Research.

- Research in action for the development of computer rooms for children (done by the Arturo Rosenblueth Foundation for the Promotion of Science and the Academy of Science). This research is part of the "Galileo - education for the 21st century" project initiated by the Foundation in 1983. In 1984 the project had three centres opened thanks to the financial support of the National Centre for Scientific Research and the Control Data corporation; then it set up a national network of twenty centres accommodating over 600 children in computer rooms each equipped with 12 to 15 microcomputers (simulation programs in geography, physics, mathematics, chemistry, biology and economics; adaptation of the Karel robot of the University of Stanford, etc.)
  In 1985 the Foundation also set in place a training programme for computer science instructors.

- Various other bodies have research programmes on the educational applications of the computer such as the ORT Foundation, the Ibero-American University, the Centre for Pedagogical Studies, the Technology Institute of Monterrey, the Directorate-General of Libraries, the Innovation and Communication Company, the TEC-BYTE computer club, the free electronics room of Puebla, the Centre of Mathematics Research of Guanajuato, etc.

FUTURE DEVELOPMENTS

The two developments on the drawing board at the moment concern first primary and then secondary education.

1. Computer assisted instruction in primary schools

This is a six-stage project, spread over five years, for the production of teaching materials. The six stages are as follows:

- Training of production staff (one year/1984).
- Production of content (duration will vary with financial and human resources available; to start in 1985).
- Experiments with first teaching modules on children in grade III of primary school (1985-86 school year).
- Production of content for other primary grades (to start in 1987).
- Experimentation with these new modules (1988-89 school year)
- Large-scale production.

2. Informatics in secondary education

The plan is to introduce the computer in secondary education both as an aid to learning and as a mathematical tool. A number of schools would be equipped experimentally with computers for use by third year pupils (end of first cycle). Initially 96 schools having under 120 pupils would be equipped (1 microcomputer per school) plus 20 schools of over 120 pupils (500 microcomputers in all).
In the former case the computer would be used as a teaching aid and as a computing instrument for the teaching of informatics. In the latter, the intention is to form different experimental groups, some schools being given pools of computers (25 per school) for the teaching of informatics, others having CAI rooms and yet others having the role of experimenting with both types of utilisation together.

This experimental project is to be accompanied by a parallel project for the production of national software and a teacher training programme (a 120 hour course and distance education). If it were decided to adopt this experimental scheme in all secondary schools some 203 000 microcomputers would have to be installed in 15 270 public schools.

Sources:

- Desarrollo de la informática en los sistemas de educación de paises de America latina y el Caribe. OREALC/Estadisticas/36.Vol I.
- Perspectivas de la computación en la educacion básica en Mexico. Lic. Procoro Millan Benitez, Dirección General de Planeación, Segretaria de Educación Publica. Aug 1985.
- El proyecto Galileo y las computadores en la enseñanza de la ciencia. Enrique Calderón. Fundación Arturo Rosenblueth, Mexico, 1985.
- Informatica y Educación. Simposio internacional 30 Apr/4 May 1984. San Miguel de Tucumán, Argentina.

M O R O C C O

Basic data

Total school population: 3 508 000 (1982)

Education budget: 6 524 387 000 Dirhams (1982)
as percentage of GNP: 7.3%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26					
Level		I	II		III	IV
Cycle	Kinder-garten	1 Primary	2 Secondary	3	4	5
			Common core	Options		
					Teach. train.	
						Higher instit.

Compulsory exami ations at end of cycles 1 to 5

	School population per level	Number of teachers per level
Primary	2 442 726 (1982)	67 682 (1982)
Secondary	968 327 (")	46 619 (")
Tertiary	96 953 (1981)	3 284 (1981)

APPLICATIONS

Research

The Arabisation Institute has developped a bilingual terminal, production of which began in 1985.

Source:

- Introduction of informatics in the educational system of the Arab world. Regional office for education in Arab countries, Unesco, Nov 1985.

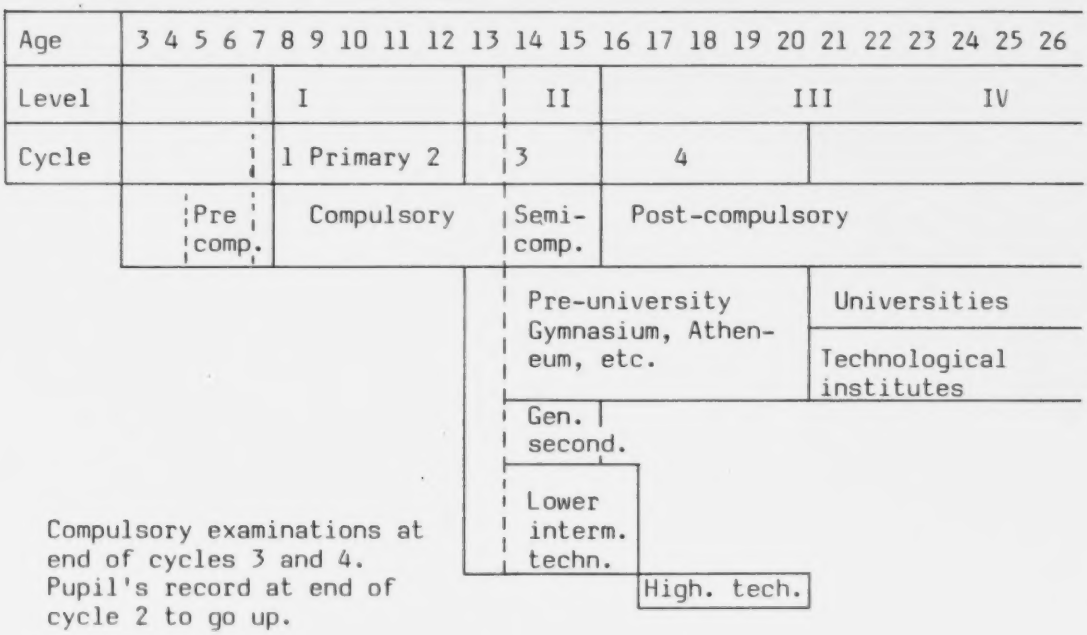
NETHERLANDS

Basic data

Total school population: 3 320 000 approx.

Education budget: 27 569 000 Guilders (1981)
as percentage of GNP: 7.9%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	1 201 512 (1982)	60 434
Secondary	1 440 242	
Tertiary	379 047	

Background

Apart from a certain amount of research and some isolated projects, there is very little use made of computers in primary education. The situation in secondary education is characterised by the existence of some minor research projects and, more recently, by a wave of spontaneous initiatives in certain establishments for the use of informatics in class.

In 1981 the Ministry of Education and Science declared the need for a national policy and set up an internal working group and a National Advisory Committee on Education and Information Technology.

In September 1982 the education Ministry presented its report on Education and Information Technology to Parliament. At the same time, the Centre for Education and Information Technology was set up with the task of supplying school establishments with the information and advice they need to introduce informatics in school. These measures are the first signs of the formulation of a national policy.

In January 1984, the Ministers of Education and Science, Economic Affairs, and Agriculture and Fishing Affairs published the Informatics Stimulation Plan, a White Paper setting out the policies for the 1984-88 period. A total investment of Gld 1 272 million will be devoted to the development and application of information technology, with Gld 267.5 million earmarked for education, to achieve the two objectives of making all citizens acquainted with the new information technologies and creating "human capital" to strengthen the market sector. The larger share of the investment (65 per cent) will go to policy developments mostly in the vocational sector with some investment in primary and secondary education. The remaining resources will be spent on creating a national, and partly regional, infrastructure for the development and distribution of software (15 per cent of total expenditure), on in-service (11 per cent) and initial (6 per cent) teacher training and on educational research (4 per cent). The target is to arrive at a situation by 1988 in which educational institutions, industry and other further education institutions are able to penetrate the remaining part of the educational field without further support. During this initial phase the Minister of Economic Affairs will focus on assisting the industrial sector in the development of the hardware, software and courseware needed in education and in supporting experimental projects resulting in practical experience and having a demonstrative effect.

Informatics policy

One of the reasons for the need for a national informatics policy is the centralised nature of the financing of the Netherlands education system. Moreover, whilst secondary education is financed directly by the central government (although supplementary equipment - including computers - may be purchased by the municipal authorities provided private and public schools are treated alike), the schools are free to decide their own curricula. Primary education (denominational or otherwise) and public education are thus wholly financed by the central government but enjoy complete curricular autonomy.

These two reasons (financing of equipment, independence of curricula) explain the need for a general national education policy and in particular that for a policy on informatics in education.

The education Ministry's policy intentions are set out in Education and Information Technology, a report submitted to Parliament in 1982. The report has a socio-economic and socio-cultural basis.

Two of the points it makes are:

- the need to prepare for adjustment to technological development in working life by offering in-service training and retraining opportunities (at school level, this translates into a proposal for changes to vocational training curricula) and

- the importance of preparing young people under 15 for foreseeable changes brought about by technological progress, similarly preparing all teachers whether they use or teach informatics or not, making allowance for children in special education, cultural minorities and the most disadvantaged members of the population and the need to provide girls with equal access to information technology, etc.

In these fields the report concludes that computer literacy needs to be introduced as a compulsory subject for all and that experimental projects should be launched (the "100 schools" project) for a period of two years, this trial period to be followed by a second phase of organised, systematic development.

Another contribution to the definition of national policy was made in 1982 with the publication of the first report by the National Advisory Committee on Education and Information Technology. The recommendations of the Committee stress the need for everyone to be informed about computers (Computer science for citizens) and urge that informatics be in the first cycle secondary curriculum (compulsory for children age 12-14).

Because of the resistance to change shown by educational circles in general, the Committee proposed that computer science be introduced in a simple form (information about...) and then to make the approach more complex once teachers were familiarised with the new idea.

The Committee therefore saw the intoduction of informatics in terms of:

- simple programmes,
- little change in lesson organisation, and
- simple, low-cost and widely used machines.

One of the central instruments for the implementation of this policy is the Centre for Education and Information Technology set up at the Twente University of Technology in 1982. Financed by the Ministry of Education, the role of the centre is to inform and advise the educational sector about the uses of computers, to stimulate aplications and to establish relations with other national and international institutions with the emphasis on cooperation in the fields of information exchange and educational software standardisation.

The other institutions with a part to play in the policy are primarily:

- Three national educational centres which assist projects launched in schools.
- The teacher training schools responsible for initial and in-service training.
- The National Foundation for Educational Research (SVO) which coordinates research by the universities and educational centres.
- The National Institute for Curriculum Development (SLO) responsible for defining the Computer Literacy programme.

PRIMARY EDUCATION

The national development plan includes a number of experimental projects spread over four years in primary and special schools. Their purpose is to research the subjects to be included in education on the new information technologies.

Parents associations and teachers unions are very have serios misgivings about the use of computers in primary school and are not in favour of the general adoption of the new technologies out of concern lest children should become dependent upon them and for reasons of principle.

Hardware

140 primary schools (1.6 per cent of the total) have 184 microcomputers in all, financed out of the normal school budget with some donations from parents.

Types of application

These, in CAI, are basic skills and to some extent remedial education and games. Computer appreciation is currently under study within the development plan. No computer science course as such is foreseen for primary schools although the principles of programming are being introduced through Logo activities, most of them organised by the Netherlands Logo Foundation.

Software

Courseware created by primary schools stems mostly from the ongoing experiments in these schools. As these experiments are usually manned by universities, the latter are also the producers of most of what exists.

Quality control

Absolute standards of evaluation do not exist. The quality of the courseware developed ranges from "adequate" to "very good".

Portability

No formal agreement exists between software writers and computer manufacturers and although recognising the importance of the issue no policy choice has been made so far by the authorities concerned. A research project now in progress aims at developing an intermediate language, between higher order computer languages of all kinds and some limited types of machine language.

Diffusion

The Centre for Education and Information Technology is the clearinghouse for educational institutions.

SECONDARY EDUCATION

The most important project at the national level is the "100 schools" scheme launched in 1983 by the Ministry of Education. The purpose of the project is to develop computer literacy in first cycle secondary education. The first phase of the project, lasting 2 years, is a test when the education sector's opinions on and reactions to the introduction of the innovation will be sought and recorded. The information gathered during this first phase will be analysed and used to fashion a coherent national strategy for the extension of the informatics development plan to the whole of secondary education (2 700 schools) based on the requirements and wishes expressed by the teachers and establishments (which, as has been seen, have the right to select their curriculum themselves and therefore to turn down innovations proposed by the Ministry).

Hardware

In the framework of the "100 schools" project, the Ministries of Education and Economic Affairs have a Gu 24 million, 5-year budget for equipping the schools. About 700 schools have so far received computers. To be more precise, 695 general secondary schools (46 per cent of the total) are equipped as are 191 first level vocational schools (14.8 per cent) and 317 vocational schools (55 per cent), the latter two categories not being covered by the national plan.

In most cases, 8-bit microcomputers have been supplied.

For the "100 schools" project, since the purpose is to support the national industry, two types of computer made in the Netherlands were chosen: the Philips P2000 and the Aster CT-80. Each of the schools selected has received 8 microcomputers on loan.

Funds come mainly from the Ministry of Education in conjunction with the Ministry of Economic Affairs. In some schools however, mainly in general education, parents associations collect the necessary resources.

Types of application

These, in CAI, are the teaching of mathematics, physics, chemistry, Dutch and foreign languages.

In the "100 schools" project the National Institute for Curriculum Development is responsible for designing the Computer literacy curriculum, the object of which is to present computer applications in daily and working life and to teach the basics of algorithms and programming. There are therefore 4 modules in the course:

- Introduction to the use of information systems.
- Data processing by computer.
- Information technology applications.
- Impact of the development of information technologies on society.

There is no computer scence course as a subject in the general education curriculum but many experts think there should be.

In technical and commercial vocational education computer science is taught for one hour a week, 40 weeks a year, and is meant for pupils who do not intend to take up computer work as a career. The programme involves insight into computer and information systems, applications of software and data bases, problem-solving and programming.

Software

Existing courseware has been developed mostly by teachers without the involvement of any central institution. Teacher training institutions are now commencing courseware development activities.

The most commonly used language is Basic or certain derivatives such as Comal 80.

Some universities have research programmes on languages. The Free University of Amsterdam is studying the ability of 12 year-olds to use a highly structured language (Pipo) derived from Pascal and the Catholic University of Nijmegen has developed a special language for secondary education.

Software diffusion

The Centre for Education and Information Technology is responsible for the distribution, nationally, of courseware and for the obtaining and issue of information about it. To this end the centre is to found a central office for producing and re-formating software. It is also responsible for providing demonstrations and courses.

Teachers

Up to 1984 the training of teachers in the use of informatics was provided by certain teacher training schools and user groups. These courses were an introduction to the basics of programming and familiarisation with the computer hardware concerned. As part of the "100 schools" project, the Ministry of Education selected 10 teacher training schools for initial and in-service training. These schools have been equipped and the instructors have been trained at the Twente Technological University and the Free University of Amsterdam. The courses for teachers relate to computer applications and their impact on society, programming and methods for teaching computer science.

Some teachers have formed user clubs, one of which - DIDACOM - has 300 members.

Sources:

- Document CERI/NT/84.02 (OECD).
- Computer Literacy in the Netherlands (G.J.Carleer) in Computers in Education, Vol 8, No. 4, 1984, pp401-405.
- The microcomputer in the teaching/learning process. The Dutch context (J.J. Beishuizen), Nov. 1984.

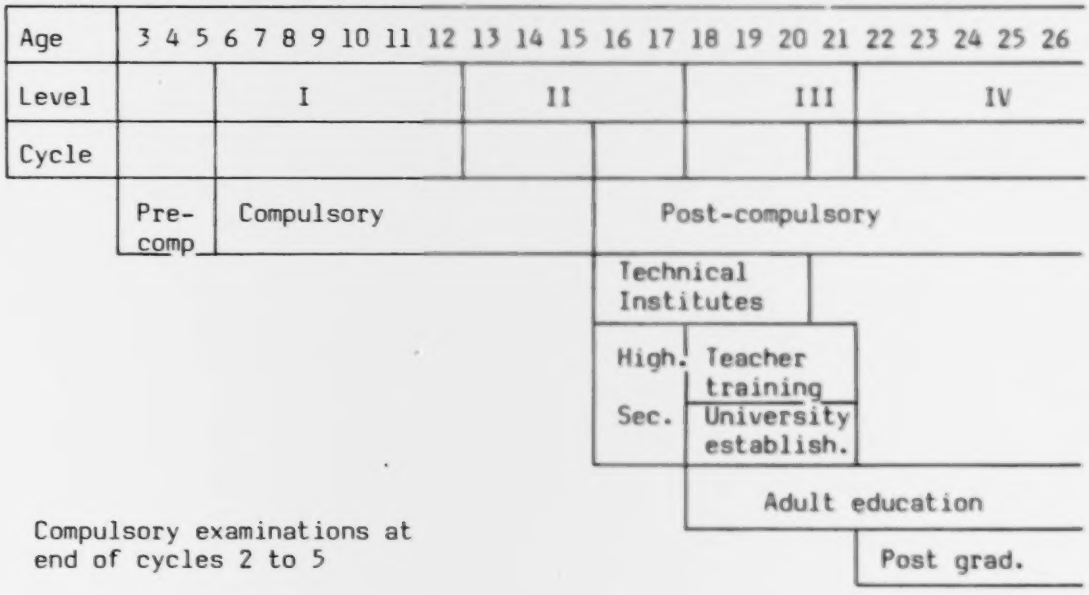
NEW ZEALAND

Basic data

Total school population: 792 700 approx. (1982)

Education budget: 1 503 860 000 dollars (1982)
as percentage of GNP: 5.3%

Structure of educational system:



Compulsory examinations at end of cycles 2 to 5

	School population per level	Number of teachers per level
Primary	359 011 (1982)	22 277 (1981)
Secondary	351 034	
Tertiary	82 666	7 753

Present situation

Two ideas are at the basis of New Zealand's approach to the introduction of the new information technologies in education (New Zealand 1982)

- The preparation of all students for a technology-oriented world: "all students should have the opportunity to learn about the uses and implications of computers and associated technologies so that they may be better informed to contribute to, and have an influence on, applications of the technology in the future".

- The definition of the computer as a teaching aid: "the computer can become another aid to the teacher performing certain tasks more effectively than could be done otherwise".

Current policy efforts are concentrated on secondary education. Concern with the primary level is, for the time being, deferred.

Hardware

About ten per cent of the country's 2 200 schools have computer equipment, mostly used for drill and practice and purchased through parents' donations to school funds.

Teacher training

Training is not generally available to primary trainees or teachers except as optional or voluntary activities at teachers' colleges.

SECONDARY EDUCATION

In October 1983 about 97 per cent of the 391 secondary schools had at least one computer. The average number of computers per school is close to five. The equipment is used mostly for familiarisation and awareness courses at the lower level and for programming and computer assisted learning activities at the upper secondary level.

Computer equipment is purchased by schools through funds raised by staff, pupils and parents.

Types of application

Curriculum - computer science

An option exists within Form 7 Applied Mathematics. The time allocation of 80 hours may be spread over the whole year or only six months. A fuller (160 hours) course in Computer Studies is offered as a Sixth Form Certificate option in an estimated 167 schools.

Curriculum - Computer appreciation

Computer awareness apears as a unit of study in Form 4. The course, of 12-30 hours, is offered by approximately 278 schools. A few schools offer full or half-year courses at Forms 3 and 4 covering material in greater depth. Information on the societal consequences is also given in the social science curriculum.

Software

Production

Some commercially available material is used in schools. However, most courseware in use has been written by individual teachers, informally, for use within the teacher's school. A little has been produced in teachers' colleges and universities. Experimental courseware has been developed by the Department of Education, using teachers and a private software firm, to provide trial material for the schools involved in the "Poly" microcomputer project.

A computer copurseware development unit is to be established at the Department of Education in February 1984.

Diffusion

A number of user groups and computer education societies exist and are the main means of access by schools to courseware. Department of Education courses also help. The main obstacles to further development are mainly geographic: the school population of the country is widely dispersed.

Transferability

Following an evaluation of hardware in 1982, five microcomputer models were named as suitable for use in secondary schools. It is intended to standardise on a language common to the five machines for the purposes of software production and distribution.

Teacher training

Massey University offers a third-year level diploma paper in computer assisted instruction. Teachers' colleges offer a variety of content and methods pre-service courses for teachers.

Source: Document CERI/NT/84.02.

NORWAY

Basic data

Total school population: 824 000 approx.

Education budget: 24 133 million Krone (1982)
as percentage of GNP: 8.8%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I II III IV
Cycle	Kinder-garten; Unified comp-rehensive 3; Integrated 4
	Pre-comp.; Compulsory; Post-compulsory
	Contin. education
	Recurrent education
	University
	3rd cyc. college
	Teacher train.

Compulsory examinations at end of cycle 3
At the end of cycle 4 there is the Artium university entrance examination

	School population per level	Number of teachers per level
Primary	372 705 (1982)	47 802 (1981)
Secondary	368 624 (1981)	31 459 (1970)
Tertiary	82 511 (")	9 555 (1981)

Background information

In Norway experiments in the field of computer education at the lower secondary level (grades 7-9) were launched for the first time in the early 70s. In upper secondary (grades 10-12) experiments had begun somewhat earlier. The teaching of computer science is now being introduced in various branches of upper secondary education and priority has so far been given to developing courses in commercial education.

In January 1984, a White Paper on information technology in schools was submitted to the National Assembly by the Ministry of Church and Education.

This parliamentary report includes a policy programme for the years ahead with a view to strengthening further research and development work in this field.

The Ministry has put forward a proposal on standard requirements for computer equipment to be used in primary and secondary schools and suppliers have been asked to compete, on this basis, for orders for equipment likely to be used as part of further research and development work within primary and secondary education.

PRIMARY EDUCATION

Hardware

Statistics are not available on the number of primary schools (grades 1-6) with computer equipment. However as primary and secondary education are given together in some cases in combined schools, some primary schools will have access to the computers usually present in the latter.

Hardware is financed by the owners, e.g. the municipality.

Types of application

The teaching of computer science is not compulsory at the primary level but computers are occasionally used in some primary schools on the initiative of a limited number of teachers.

LOWER SECONDARY EDUCATION

Approximately 200 out of 1 100 schools are computer-equipped, financed by the owner, e.g. the municipality.

Types of application

Curriculum - computer science

Computer science is offered as an optional subject at the rate of 2 lessons per week in grade 8 or 9 at approx 200 out of 1 100 schools. At some of these schools priority is mainly given to programming whilst other schools are studying the possible utilisations of computers and the role of computer technology for the individual and for society as a whole.

The Basic School Council is working on a draft framework plan for the teaching of computer science as a compulsory topic within other subjects such as mathematics, natural science, Norwegian and civics.

Software

No system has yet been organised for the national distribution of software. However, in the south east of the country a number of municipalities have been cooperating in the "DAISY" project. Among other things, this project is aimed at developing and distributing software in the participating municipalities.

Teacher training

No systematic training is available for teachers already in service. Voluntary in-service courses are organised and practising teachers are free to apply for admission to them. Eight colleges of education are providing half-year courses for primary and secondary teachers. They may be taken either as part of initial training or as continued training. A limited number of teachers have been studying data processing at universities and regional colleges but these courses are not specifically intended for teachers. Many teachers also attend voluntary evening classes in data processing at private institutions.

UPPER SECONDARY EDUCATION

The majority of schools are equipped. They have freedom of choice in hardware and a variety of different types therefore exist. The owner - the county authority - provides the finance.

Types of application

Curriculum - computer science

This is an optional subject - 2 lessons a week for one year. The curriculum includes the use of the computer as well as programming and the impact of information technologies on the individual and society as a whole. About 60 per cent of schools offer computer science as an optional subject. At some schools advanced courses are also available in a second year (3 lessons per week).

Curriculum - computer appreciation

Besides the instruction included in the computer science courses (see above), some schools offer a specific and compulsory course (10 lessons a year).

Teacher training

Most of the teachers in charge of the optional courses (2 lessons a week) have had less than half a year's training in the field. No systematic in-service training is offered. Eight colleges of education have half-year courses which may be taken either as part of initial training or as continued training. Some teachers have studied data processing at universities and regional colleges and many also attend evening courses organised by private institutions.

VOCATIONAL EDUCATION

Hardware

All upper secondary schools offering commercial and clerical subjects are equipped. Computers are also to be found in a number of schools offering vocational education in handcrafts and industrial subjects.

Financing

The hardware is financed by the owner of the school, e.g. the county authority, central government subsidies ranging from 35 to 75 per cent of the actual cost. In some cases the equipment is paid for completely by the central government especially in the case of high-cost investment in schools selected to be centres of knowledge in this field.

Types of application

Curriculum - computer science

For commercial and clerical streams the course has optional and compulsory components differing in their distribution over the three years. The heaviest curriculum load is in the "computer and information processing" branch where the course lasts 38 weeks at the rate of 15 lessons a week. Data processing is being introduced to an increasing extent in vocational trades, examples being numerical control of workshop machinery and microprocessor applications in the electrical trades and in automatic welding equipment. In the book trade, too, data processing has been introduced on a large scale. A specific optional course in computer science (one year, 2 lessons a week) has been developed for students in the vocational areas of study.

Curriculum - computer appreciation

Apart from the instruction included in computer science, some schools offer a specific and compulsory course (10 lessons a year).

Teacher training

For vocational teachers it seemed particularly important to raise the general level of compuiter knowledge.

Combined training programmes organised by private correspondence course institutes have been recognised as basic training. One of the central tasks for the centres of knowledge that are to be set up will be to organise continued and in-service training for teachers within the respective regions.

In cooperation with industry and vocational schools, the State Institute of Technology has prepared programmes for courses in numerical control. Similar programmes are in preparation for the book trade.

The State College of Vocational Education is currently at work on an extensive programme for a course in general computer knowledge for teachers.

Source: Document CERI/NT/84.02 (OECD)

P A R A G U A Y

Basic data

Total school population: 725 155

Education budget: 5 627 500 000 Guaranis (1980)
as percentage of GNP: 1.3%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Level	I II III IV
Cycle	1 2 3 4 5

Pre-comp. | Compulsory | Post-compulsory

Common cycle

Scientif. humanist Technical vocation.

Teach. train. | University

Compulsory examinations at end of cycles 2 to 5

	School population per level	Number of teachers per level
Primary	539 889 (1982)	20 746 (1982)
Secondary	164 464 (")	
Tertiary	20 802 (1980)	

Informatics policies

By means of a policy of regionalisation of education and improvement in the organisation and administration of the educational system Paraguay hopes to have 95 per cent of its children age seven to twelve at school by the year 2000. The use of computers has to be seen against this background.

Because of the need to define a national informatics policy a Provisional Committee was set up with the task of instituting a National Commission for Informatics and Technology. The Ministry of Education was closely involved in the work of the committee.

As yet however there is no central body reponsible for the development of informatics at national level and the country has no domestic production of computer hardware.

BASIC AND INTERMEDIATE EDUCATION

At the pre-school, primary and intermediate levels computers are to be found in only a few private schools. They are wholly absent from the public establishments at these levels and curricula have no content specifically relevant to informatics. For these reasons there are no arrangements for the training or retraining of teachers in the subject.

HIGHER EDUCATION

The use of computers in terms of CAI and an evaluation tool is fairly widespread in higher education.

MANAGEMENT APPLICATIONS

At the Ministry of Education and Religion, the first applications related to administration, primarily that of staff pay and contracts.

In the next three years it is hoped to extend applications to accounts and budgeting, inventories and the management of administrative and teaching staff records. Another field of application is that of the national examinations. It is also hoped, in the near future, to use the computer for vocational guidance purposes and the management of pupils records.

The Planning Department sometimes uses computers in educational research.

By 1988 there are expected to be new applications such as the analysis of academic performance, simulation and the management of human and physical resources.

The various information systems that exist were all designed and developed as centralised systems but their use is in its infancy as yet; decisions are to be taken in 1985 about the type of hardware that should be used by the Ministry's administrative services.

At the time of writing, the hardware in use at the Ministry of Education and Religion consists of one ONTEL OPI/70 microcomputer (DOS, 64K, with diskette drive and hard disc facility) connected to four terminals.

Source: Desarrollo de la informática en los sistemas de educación de paises de America Latina y el Caribe. OREALC/Estadisticas/36 Vol I, March 1985.

P H I L I P P I N E S

Basic data

Total school population: 13 000 000 approx.

Education budget: 6 581 205 000 Pesos (1982)
as percentage of GNP: 2%

Structure of educational system: Not available

	School population per level	Number of teachers per level
Primary	8 591 267 (1982)	272 134
Secondary	3 092 128	90 266
Tertiary	1 335 889	44 505

Number of computers in use

The number of computers in use in the country increased at an average rate of 29.5 per cent a year between 1971 and 1980.
In 1980, a count showed there were 327 major systems, 79.7 per cent in the private and 20.3 per cent in the public sector.
General education and vocational training account for 3.76 per cent of users.

Informatics policy

Government decrees lay down the lines of national informatics policy. Decree 1380 encourages the development of computer literacy and the use of computers in the public sector, education and industry. It recommends the acquisition of computers costing under 2 million pesos (the purchase of higher price range equipment has to have the prior approval of the National Computer Centre for both public and private sectors).

Decree 1381 sets up an ad hoc sub-committee to investigate the role of the computer in economic development. The sub-committee is assisted by a technical unit.

A compulsory course on "Informatics and society" has been added to the higher education curriculum. In conjunction wiht industry and other government bodies, the Ministry of Education has defined the programmes for various divisions of training in information technology: computer science, information systems, computer engineering, etc.

PRIMARY AND SECONDARY EDUCATION

A study is under way on the implementation of a computer literacy programme in primary and secondary education.

VOCATIONAL TRAINING

The number of people with computer training in 1982 was 6 744 against real needs of about 10 000.

In the public sector, training is provided by the Ministry of Education and the National Computer Centres, TRC, DAP and NMYC. In the private sector it is given by computer manufacturers, certain schools and private training centres.

TEACHER TRAINING

Since 1983 the universities have been providing training for teachers in higher and secondary education. About 500 teachers are enrolled at the moment.

In 1984 the Delasalle University opened a second cycle course leading to a master's degree in computer science intended for future teachers. The first cohort of graduates should come through in May 1985.

A specific curriculum is to be brought in. It will have three phases: an intensive two-weeks initiation course, practical work on projects and a phase in which the teachers, in their turn, become the instructors of their working colleagues.

INFORMAL EDUCATION

There are 145 computer training centres offering basic computer, programming and systems analysis courses and training courses for operators. Government regulations effective from 1984 now govern this type of training in order to provide some guarantee of quality.

Some organisations equipped with computers give on-the-job training and computer manufacturers offer traininmg in the use of their products.

Lastly computer literacy programmes have begun to be broadcast once weekly on television.

Other activities

There are also three trade associations and many computer clubs. Their activities range from the holding of competitions to the teaching and learning of basic techniques. The trade associations also play an active part in industrial research, the definition of policy and computer awareness programmes.

Source: Final report of the third Asian seminar on educational technology in Tokyo. 26 Sep/2 Oct 1984, APEID 1984.

POLAND

Basic data

Total school population: 6 319 000

Education budget: 311 300 million zlotys
as percentage of GNP:

Structure of educational system:

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Grade				1	2	3	4	5	6	7	8		I	II	III	IV	V							
School	Kinder-garten			Basic									Lyceum											
													Technicum											
													Vocation. school											
	Compulsory																							

	School population per level (1984)	Number of teachers per level
Basic schools	4 671 100	276 000
Secondary general schools	330 000	20 000
Technical and vocational	1 318 000	78 500

Number of microcomputers in schools: 3 000 approx.

Number of microcomputers in Poland: 100 000 approx.

Key dates in the introduction of informatics in education

1970: Seminar on informatics for mathematics teachers organised by the Institute for Educational Research. Experimental computer lessons introduced in a secondary school in Warsaw.

1974: Study of informatics introduced by the Teacher Training Institute. To date about 1000 teachers have successfully completed the course.

1975-80: Teaching of informatics introduced in about 600 secondary and technical schools. Mainframe computers used in various computer centres. Later the number of schools giving these courses declined.

1983: Computer hardware bought for schools from local resources or out of teachers' own pockets.

1984: 300 microcomputers provided for schools by a private firm. Software developed and presented at the international conferences on the teaching of physics.

1985 Advisory Committee on Informatics set up by the Minister of Education.

Rapid growth in the number of microcomputers (up to 3 000) purchased with local resources. Students micro clubs organised. Lessons on informatics begun in some schools. Microcomputers used in teaching other subjects.

Participation of Polish delegation at international meetings. Decision to appoint a council of experts for informatics in the socialist countries.

Decision by Ministry of Education to introduce informatics as an optional subject in secondary schools in 1986/7.

Approval by Ministry of Education of Project of Informatics Education and Computer Technology for 1986-1990 which sets out goals, strategies and ways and means. The project will now be presented for government ratification and will then be introduced nationally.

PROJECT POLICY

The Ministry of Education has a twofold objective:

- to create awareness of the role and importance of microcomputers in modern life (computer literacy);
- to create the background for the training of skilled specialists in science, technology and business.

Particular attention is attached to the folowing aspects:

- introducing information technology in teaching methods;
- providing schools with microcomputers having the appropriate characteristics; the development of educational software and development and diffusion of the best methods of using microcomputers in teaching;
- the training of teachers in information technology and CAI.

Present situation

The problem of the largescale introduction of microcomputers and information technology in education is a major concern of the Ministry of Education and other agencies involved. The lack of equipment is a serious constraint. The 1986-1990 Plan assumes that domestic production of school computers will have commenced. Several scientific and social institutions are cooperating in developing and promoting the Plan, e.g. the Polish Informatics Society, the Polish Cybernetics Society and the Chief Technical Organisation.

The School Applications of Microcomputers Division of the Institute for Educational Reseach has studied methodologies for using microcomputers in school and the design and evaluation of educational software. KODY, a seminar on Computers in Didactics, has been set up with a view to developing these issues and preparing a body of specialists able to put information technology to use in schools across the country.

Because of their great interest in informatics, many schools purchase computer equipment out of their own resources, their activities varying to students' demand. Thus different types of equipment are found in different types of school throughout the country.

Hardware

The number of microcomputers in use in schools is estimated to total about 3 000, about 75 per cent of which are probably in vocational secondary schools. Most are the Sinclair ZX Spectrum. There are also about 600 domestically produced Meritum microcumputers. Cassette tape recorders are mainly used for storage.

Types of application

Some schools are running courses on informatics using their own experimental syllabuses. The Ministry of Education-approved syllabus will be introduced in 1986/7. Informatics will be taught as an optional one-year course of 75 periods for general secondary schools. The scheme will be phased in as suitable hardware and trained teachers become available. Some teachers are already using microcomputers in lessons on other subjects, primarily mathematics, physics and technology.

The most common applications are in students' microcomputer clubs.

Software

No professionally designed software is yet available. Teachers use programs made by themselves or students or borrow them from colleagues. The task of designing and evaluating standards for educational software has been shouldered by the Microcomputer Applications Section of the Institute for Educational Research.

Teacher training

Some teachers have taken informatics courses when at university. Training is on mainframe computers where access to keyboards is not easy. In practical terms, therefore, teacher training has to be tackled from the very beginning. The Institute for Teacher Training has an in-service informatics training course of 300 hours in one year, attended by 60 mathematics and physics teachers and Divisions in the Institute intend to organise a variety of in-service courses.

Information technology in school administration

The Ministry of Education's computer centre has been in operation since 1976. School administration statistical data are processed and analysed in this centre. For teachers' records the Ministry operates an EWIKAN information system connected to a network of ZETO computer centres.

To met the growing demand for data for administrative management and educational information, the creation of a large information centre is planned. Several systems will store and process data for economic and financial management, staff control and to create databases of teaching aids and equipment, teaching materials and syllabuses, textbooks, readers, bibliographic catalogues, etc.

Future developments

The project approved by the heads of the Ministry of Education on 30 October 1985 provides a formal basis for this activity from 1986 to 1990. The Project calls for the provision of 75 000 microcomputers at a total cost of 5 000 million zlotys. The scheme is to have microcomputer laboratories equipped with 10 machines each in every general and vocational secondary school. The Project also strongly urges the promotion of largescale domestic production of microcomputers and peripherals.

P O R T U G A L

Basic data

Total school population: 1 753 800 (1982)

Education budget: 65 983 200 000 Escudos (1981)
as percentage of GNP: 4.7 %

Structure of educational system:

Age	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Level				I						II								III				IV
Cycle				1				2		3				4								
	Pre-comp.			Compulsory						Post-compulsory												
				Primary				Sec.		Unified sec.				Spec. sec.								
														Spec. techn.								
														Primary and pre-primary teacher train.								

	School population per level	Number of teachers per level
Primary	1 223 127 (1981)	65 124 (1978)
Secondary	438 474 (1978)	29 714 (1975)
Tertiary	92 152 (1980)	10 695 (1980)

Current situation

PRIMARY EDUCATION

The state schools are not involved for the time being but it is quite possible that the new information technologies may be introduced in the near future in experimental conditions.

SECONDARY EDUCATION

There has been no largescale introduction of the new technologies in secondary schools but a two-year experimental programme is being carried out by the University of Oporto with the object of introducing computer assisted instruction at grades 10, 11 and 12 in two to four secondary schools. The planned investment on hardware is 60 065 US dollars a year for a number of computer configurations large enough to allow seven hours a week interactive work for groups of three pupils each.

Curriculum - Computer science

Informatics is one of the optional vocational subjects in secondary education. The course lasts one school year and has been introduced at grade 12 (school-leaving year) in about ten per cent of schools.

Curriculum - computer appreciation

No separate courses exist. The subject matter is discussed in the economics classes and could in future be part of the social studies curriculum.

Teacher training

There is no provision for the training of teachers in computers.

Source:

- Document CERI/NT/84.02 (OECD).

S A U D I A R A B I A

Basic data

Total school population: 1 445 133 (1981)

Education budget: 31 404 195 000 Rials (1982)
as percentage of GNP: 5.8%

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	994 901 (1981)	55 836 (1981)
Secondary	379 575 (")	29 573 (")
Tertiary	70 657 (")	8 043 (")

APPLICATIONS

Research

Research has begun on the development of an Arabic computer language (KATEB) close to the Pilot language.

Source:

- Introduction of informatics in the educational system of the Arab world. Regional office for education in Arab countries, Unesco, Nov. 1985.

S E N E G A L

Basic data

Total school population:

Education budget: 27 500 million CFA Francs (1980)

as percentage of GNP:

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	452 679 (1981)	10 586
Secondary	103 821	4 834
Tertiary	12 522	925

Background

A diagnosis of the informatics situation led, in 1972, to the formation of structures for the definition, implementation and enforcement of a national informatics policy: the National Informatics Committee (CNI) which meets once a year in the form of an interministerial council and the Directorate for Automatic Data Processing (DTAI).

The CNI is reponsible for:

- drawing up master plans for informatics, and
- stimulating and coordinating action in this field in the public and semi-public sector.

The Permanent Secretariat of the CNI is provided by the Organisation and Methods Office (BOM) attached directly to the Secretariat-General of the President's Office. Any state body wanting to install computer equipment or to consult a computer service and consultancy company must first apply to the CNI through the BOM.

The DTAI executes the policy defined by the CNI and is responsible for introducing and running computer applications in the administration and public establishments.

The informatics master plan produced in 1978 set the following objectives:

- A set of standards to be proposed in order to ensure coherence in computer applications.
- Computer cost accounting to be introduced at the DTAI in order to persuade users of computer facilities to be more economical.
- Action to be taken to give users and government servants and agents an introduction to and training in informatics.
- Administrative handling to be standardised (nomenclatures, files, etc.).

Computers in use

There are 243 computers (172 of them microcomputers) in the country as a whole. The annual growth rate is 35 per cent. All systems are imported and marketed (via local distributors) by the big international computer firms.

The software production and distribution market is dominated by six computer service and consultancy companies.

Applications

About 50 per cent of the computers in use are operated by the public service, national companies and mixed economy companies.

- 85 per cent of applications relate to administration and statistics.

- 1 per cent relates to scientific applications, one of the most important being that developed since 1974 at the Directorate for Innovation and Technological Progress (Ministry of Scientific and Technical Research) in the field of databases on:

- scientific activities in Senegal (programme for analysing scientific and technical potential), and

- national documentary resources (National Centre for Scientific and Technical Documentation.

- 0.5 per cent relates to educational applications.

Manpower

In 1982 there were 650 computer workers including 120 engineers and analysts and 115 analyst-programmers and programmers. Additional needs at the time were estimated at 110 people.

63 per cent of computer workers are in the public and para-public sector.

International cooperation

There is a regional Centre of the Intergovernmental Bureau of Informatics (IBI) at Dakar. It organises seminars and further training courses for computer workers and users in the states of the sub-region.

It also offers training scholarships to students and helps finance training programmes in the sub-region's computer schools. It plans to build an industrial microcomputer production unit and is looking for a partner in this venture.

Applications

PRIMARY EDUCATION

Logo pilot experiment

The Pedagogical Research Centre of the higher level teacher training school (ENS) in Dakar has been experimenting with Logo since 1982 in the framework of an Informatics Education Laboratory. The project was set up on the threefold initiative of the World Centre for Informatics and Human Resources in Paris, the State Secretariat for Scientific Research and the Ministries of National Education and Higher Education.

In preparation for the experiment, a pluridisciplinary team consisting of a computer specialist, a sociologist, two primary teachers, an educational psychologist and a mathematician were trained at the Logo Computer Centre, New York. Linguists and psychiatrists are also to join the team shortly.

The experiment is being done with a sample of schoolchildren from five primary schools in the Dakar conurbation representative of socio-economic and cultural conditions in Senegal. Ten pupils of differing scholastic performance (mediocre to good) attend Logo sessions lasting 90 minutes three times a week.

The experiment is now at the evaluation stage based on observation of the schoolchildren, a survey by questionnaire answered by teachers and parents and the analysis of the childrens' diskette files.

The Laboratory team is also running a research in action programme on grammar (conjugation), language (a Logo-Wolof language has been developed on Micral), geometry, modern mathematics and assistance to pupils having difficulties in class.

The team's idea is to have 10 microcomputers installed in each school in the experiment. Teacher training has already begun with this in mind with the provision of one free access microcomputer per school and the assistance of an instructor from the Laboratory who visits the school twice a week.

Directions for the planned extension of the Laboratory's activities are increasing teachers' awareness, formulating a strategy for penetrating teacher training centres and schools, operating support teaching using the microcomputer for pupils in difficulty and introducing computers in pre-school education.

INFORMAL EDUCATION

There is a Microtel club and an association of the micocomputer clubs of Senegal (ACMIS).

ADMINISTRATIVE MANAGEMENT APPLICATIONS

Every year, the Directorate of Research and Planning (DRP) of the Ministry of National Education publishes statistical yearbooks on elementary education (since 1977/78) and intermediate education (since 1981/82) on the basis of the data processed in the DTAI computer centre.

The statistical tables give figures on numbers of pupils and teachers, state of the fixed and movable assets, distances travelled by schoolchildren and the national languages used.

In addition the DRP uses an education costs simulation model, run on an IBM-PC with Multiplan software, which enables 15-year projections to be calculated and facts for decision-making presented, taking the following data into account: the education budget/general central government budget ratio, unit cost per schoolchild, numbers at school (pupils and teachers) and enrolment ratios.

An application relating to the management of educational staff is being developed using the Logabax system.

The DRP is considering the installation of a microcomputer network connected to the DTAI computer centre so that a system can be introduced for managing school supplies and materials, movable and immovable property (maintenance), the construction of new decision models and better control of statistical processing.

FUTURE DEVELOPMENTS AND PROSPECTS

Senegal is considering being connected into French and European databases via international on-line data services (Telesystèmes and Spidel).

Another project is to set up an Institute for Research in Mathematics and Applied Informatics (IRMIA) in collaboration with the Ministry of Higher Education.

Lastly there is a programme for equipping research centres (agricultural, medical and pharmaceutical centres in particular) with computers. The first to be so equipped is the Thiaroye Centre for Oceanographic Research (CRODT).

Source:

- L'informatique dans l'éducation en Afrique de l'Ouest. Document produced for BREDA by S. Dioum, DTAI, Dakar, Nov 1984.

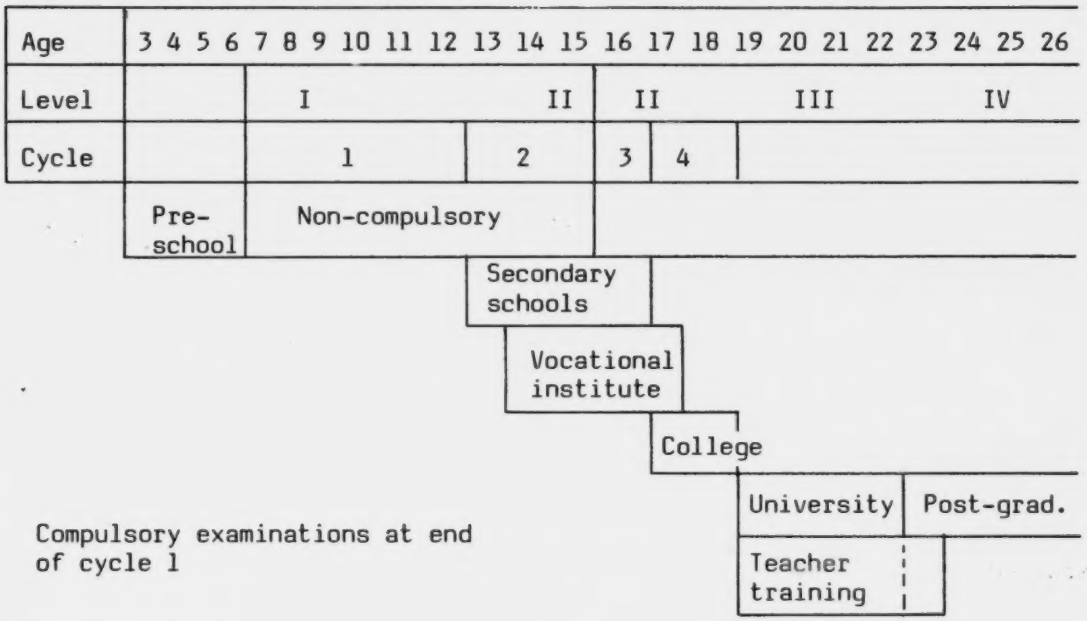
S I N G A P O R E

Basic data

Total school population: 507 206

Education budget: 1 358 429 000 Dollars (1982)
as percentage of GNP: 4.5%

Structure of educational system:



Compulsory examinations at end of cycle 1

	School population per level	Number of teachers per level
Primary	289 092 (1982)	10 286 (1982)
Secondary	187 148 (")	10 231 (")
Tertiary	30 966 (")	2 052 (")

Key dates in the development of informatics

1980 The Government sets up a Committee on National Computerization (CNC) to define a strategic master plan for the country's information technology development.

1981 A National Computer Board (NBC) is made responsible for implementing the development plan defined by the CNC and is given a threefold task:

- Organise the computerisation of the administration.
- Coordinate computer training (educational and vocational).
- Develop and promote the computer services industry.

NBC's first priority was to form a core of computer specialists to operate the plan for the computerization of the administration.

1982 An Industrial Development Department is set up to develop the computer services sector.

Computerization policy

Computer education policy is defined by the National Computer Board which has set up its own ad hoc committee made up of members of the NBC and representatives of the professional associations, government training institutes, the National University of Singapore and the Ministry of Education and members of the secretariat for vocational examinations which is itself part of the NBC.

The committee has an advisory function in the planning of manpower requirements, the definition of curricula and standardisation. The examinations secretariat (set up in 1982), for example, lays down the skills required of school-leavers trained for computer work.

APPLICATIONS

Secondary education

For the moment, computers are only available to secondary schoolchildren through extra-mural activities. 134 schools have formed Computer Appreciation Clubs each of which has 3 microcomputers.

About 700 teachers have been trained to organise the activity of these clubs which are attended by a total of 13 000 children (about eight per cent of the school population at this level.

The plan is to enlarge the capacity of these clubs to cover twenty per cent of the school population and even to introduce introductory courses in school curricula.

Informal education

Microcomputer awareness courses for the general public are organised by three institutions: the Association of the People, the National Trade Union Congress and the National Association of Army Reservists.

About 30 000 people are estimated to have attended these courses which range from awareness and initiation to learning simple programming languages.

Source: Final report of the third Asian seminar on educational technology in Tokyo. 26 Sep/2 Oct 1984 (APEID 1984).

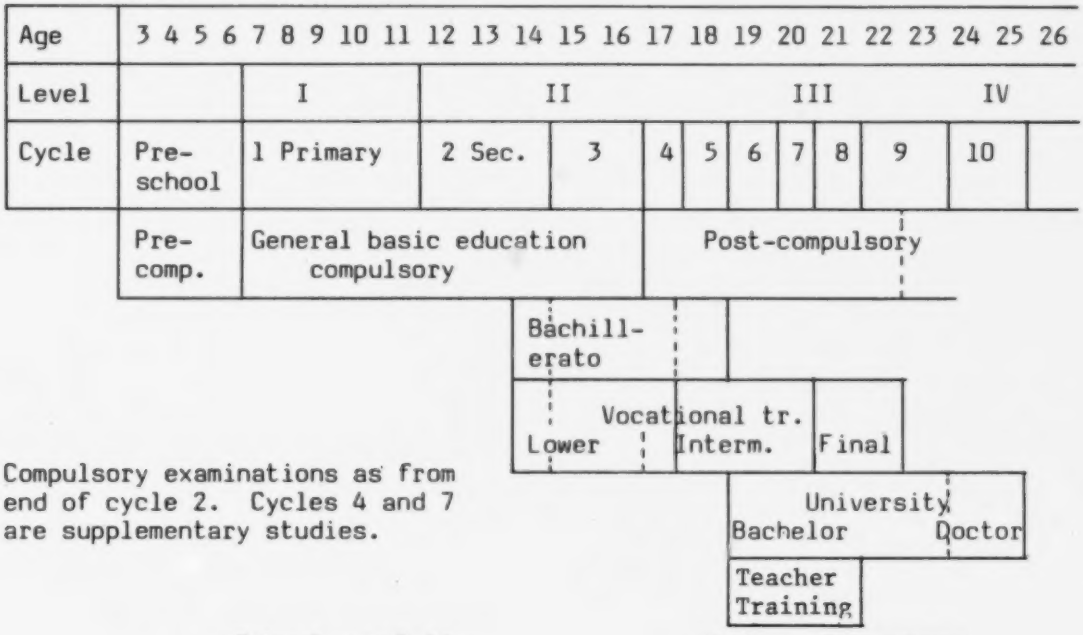
S P A I N

Basic data

Total school population: 8 378 000 approx. (1981)

Education budget: 342 376 million pesetas (1980)
as percentage of GNP: 2.6%

Structure of educational system:



Compulsory examinations as from end of cycle 2. Cycles 4 and 7 are supplementary studies.

	School population per level	Number of teachers per level
Primary	3 633 713 (1981)	214 391
Secondary	4 039 580	
Tertiary	704 310	44 241

Background information

1960s The new information technologies are first introduced in higher education establishments.

1968 "Permanent" courses on the new technologies are introduced as part of the Science Faculties' programme.

1969 The Institute of Informatics is set up as an independent entity within the Ministry of Education and Science.

1970 Experiments on the introduction of the new information technologies in schools are started on a voluntary basis and in scattered fashion throughout the country. The trend continues for the whole decade without central control or evaluation.

1976 On the basis of its seven years experience, the Institute of Informatics is integrated in the Vocational Education and Higher Education Sections of the Ministry.

1978 Following the recommendation of an international conference on "Strategies and Policies in Informatics" held under Unesco patronage, the Spanish Government decided to formulate a national plan to introduce informatics at all levels of education.

1980 The new Spanish Constitution is brought in.

1981-83 The primary and lower secondary levels of education are reformed:.

1984 A National Electronic Plan is adopted making compulsory the introduction of informatics in primary and secondary education and the Ministerial Commission on Informatics of the Ministry of Education and Science decides that informatics be introduced in pre-university education and sets up a working group with representatives of the Secretariat-General for Technical Education, the Directorates-General for Primary Education, Secondary Education and staff and services, the Commission on School Buildings and Equipment, the polytechnic universities of Madrid and Barcelona and the Directorate-General for Electronics and Informatics in the Ministry of Industry.

PRIMARY AND SECONDARY EDUCATION

In 1984 the Ministry of Education conducted a survey among school establishments in those regions where the decentralisation of responsibilities in educational matters had not yet been effective (12 regions out of 17). The survey, designed to give a picture of the situation with regard to computers in pre-university education, revealed the following:

- No use is made of computers in primary education.
- In secondary and technical education, 30 per cent of establishments are equipped with the minimum of hardware necessary.
- Vocational training establishments are under-equipped by comparison with other secondary schools, despite the fact that they are responsible for providing computer training.
- Public establishments are better equipped than private (70% v 30%) but the extent to which each school is fitted out with both hardware and software is felt to be inadequate in every case.

- Practically all of the establishments equipped use Basic though a very small number use Pascal, Logo and Plato.
- In 85 per cent of cases the equipment is used for teaching informatics, in 40 per cent for teaching other subjects and in 28 per cent for administrative purposes.

After analysing the results of the survey, the Ministry of Education and Science launched a pilot project in 1985 to rationalise the introduction of informatics in education with the object of putting an end to the anarchy reigning in the equipment of establishments and the disparities in the extent to which resources were used. This project is planned to go on for five years and concerns the 12 regions where decentralisation of educational authority has not been put into effect. The educational objectives of the project are to allow pupils to acquire some basic knowledge about computers and to understand their possible utilisations and also to make of the computer a tool to facilitate learning. The project therefore recommends that informatics be used in all subjects and by all schoolchildren without distinction of any kind.

The emphasis in the project is on teacher training. The training arrangements are that the first teachers to be trained will train their colleagues and so on, in a cascade process. The intention is that the "Centros de profesores" set up by decree in 1984 will be equipped with the necessary computer hardware and will host two specialist computer science teachers. It is hoped to train 7 439 teachers in this way between 1985 and 1990.

As to what establishments should have in the way of hardware itself, the project lays down no special rules except for the choice of the most widely used and lowest-priced computer available on the market in any given range.

In order to make sure of compatibility and transferability of software, the choice has gone to microcomputers run by a single operating system: CP/M for 8 bit micros and MS-DOS for 16-bit micros.

The average configuration is 5 microcomputers per class for 2 237 schools (out of the 28 000 there are at this level).

The Ministry of Education's budget for the hardware is 3 691 million pesetas over five years and it is hoped that the operation will stimulate the national computer industry.

Software

In the software area, the choice went to Basic, Logo and Pascal as languages and to programs for word processing and data file and base management plus an authoring language, everything having to be documented in Spanish.

Most activities will develop on the basis of the Logo language, the authoring language being intended to enable teachers to develop specific programs as necessary.

As regards courseware, there are practically no programs in Spanish at the moment and the translation of existing software poses enormous - primarily cultural - problems. It has therefore been decided to set up an Association for the Development of Educational Software with representatives from the Ministry of Education, the school milieux, hardware manufacturers and textbook publishers. The various agencies will be required to contribute financially to the software production scheme, for which the Ministry of Education is planning to invest 524 million pesetas over five years.

Pilot project Computer literacy - teaching of informatics

In 1981 the Government of the Basque province laid down a policy for the diffusion of the new technologies at regional level. The Department of Industry organises training courses for business firms and is setting up public computer centres (microcomputers and CAI systems).

In 1982 it was decided to finance a pilot experimental introduction of informatics in secondary education (second cycle and vocational training). The project was designed by the San Sebastian informatics faculty and approved by the government of the province in 1983 which decided to launch it in Guipuzcoa and to add two other areas in 1984.

Ten schools (5 general second cycle and 5 vocational training establishments were each equipped with ten microcomputers at a cost of 26 million pesetas, and three teachers in each school took a 120-hour course.

Instruction began in 1983. The objective is to integrate the teaching of informatics itself in a general understanding of its social and economic implications. Programming instruction is based on the "Robot-Karel" system.

It is intended that the Institute of Education Sciences of the University of the Basque country, as well as the team master-minding the project, should be involved in the evaluation, planned for 1984, prior to its possible extension.

HIGHER EDUCATION

There have been computer facilities in higher education for over twenty years but the universities all equipped themselves independently of one another so that there are wide differences in the hardware available.

This prompted the Ministry of Education to campaign for the interconnection of the different systems and the development of scientific databases for education and research. A number of projects were launched with this end in view:

- IRIS, a project for the creation of a network linking together the computer systems in universities and research centres.
- ODIN, a project for the purchase of a computer for use by the Ministry of Education for arithmetical purposes.
- The "database" project, namely the application of the recommendations of the National Documentation and Scientific Informatics Plan for the development of a data management infrastructure at the national and international levels and the conversion of the scientific community from its traditional role of consumer of information to producer of information.

Databases already in existence are:

- LEDA (educational legislation, computerised), produced by the Data Processing Centre.
- ISOC, a bibliographical database embracing Spanish output in the social and human sciences since 1975 produced by the Social Sciences Information and Documentation Institute of the Higher Council for Scientific Research.
- BIDE, the Spanish/American databank on education, produced by the Ibero-American Bureau of Education.

Databases in process of being set up are as follows:

- DEDALO. Educational documentation produced by the Educational Documentation and Information Centre of the Ministry of Education.
- REDINET. Databank on educational research produced by the same centre.
- TESEO. Bank of theses written in Spanish universities since 1976, produced by the Data Processing Centre of the Ministry of Education.
- DELOS, a documentary databank on software.

Sources:

- Document CERI/NT/84.02 (OECD).
- Luiz Felipe Paradela Gonzales: Politica española para la introducción de las nuevas tecnologias de la información en el sistema educativo. Ministerio de Educación y Ciencia. Spain, 1985.
- Informática y Educación. Simposio internacional, 30 Apr/4 May 1984, San Miguel de Tucumán, Argentina, 1985.

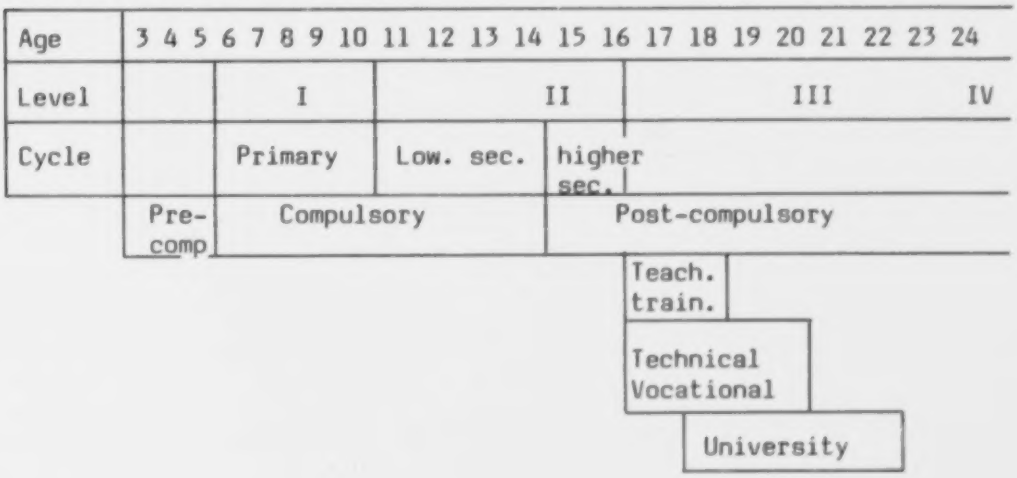
S R I L A N K A

Basic data

Total school population: 3 500 000 approx.

Education budget: 2 485 499 000 Rupees (1981)
as percentage of GNP: 3%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	2 153 595 (1983)	133 658 (1983)
Secondary	1 315 062 (1982)	
Tertiary	57 352	4 120 (1982)

Number of computers in use

There are about 1 000 microcomputers and 100 mini and mainframe computers in all, the former used in schools, etc. and offices and the latter in the big public and private sector firms and commercial businesses.

Historical background to the introduction of informatics in education

Up to the year 1977 an extremely restictive commercial policy (particularly with regard to hardware imports) allowed the country no access to modern information technologies. When the doors were opened to foreign trade, whilst the products of the electronics "revolution" penetrated commerce and industry, the deficiencies of the educational system in the fields of training in electronics and information technology were keenly felt.

In 1977 the Computer Society of Sri Lanka (CSSL) was set up which helped to popularise the profession and create awareness among political circles by means of seminars, exhibitions and public demonstrations. Vocational examinations are a CSSL responsibility.

In 1983, following a declaration by the Head of State on the urgency of doing something about the new technologies, the Computer and Information Technology Council (CINTEC) was set up with a role of stimulation rather than regulation. Its first conclusions stressed the importance of developing computer literacy at school and the equipping of universities and higher education establishments.

At these two levels implementation is the reponsibility of the Ministry of Education and the Ministry of Higher Education respectively, co-ordination being that of the Sri Lanka Inter-University Computing Committee (SLIUCC).

Present situation

It would seem possible to meet medium level training requirements by the intensive courses provided by the schools and the private sector. But needs in terms of long higher-level courses are not being met. The situation in this area is worsening because of the departure of highly qualified personnel elsewhere and the transfer to the private sector of those who stay.

The computerization policy is therefore held back by economic constraints which it does not seem possible to resolve in the short term.

COMPUTERIZATION POLICY

Policy decisions are taken at the presidential level via CINTEC. As regards education, decisions are taken by the School Micro-electronics Programme Committee of which the Minister of Education is chairman. The main lines of education policy in the information technology area are characterised by the twofold concern to develop general computer literacy and to keep computer science as an optional subject, not included in the examination syllabuses.

The introduction of informatics in the educational system has to be gradual and a downgoing process from the higher to the lower levels. This choice is dictated by logistic reasons although the educational authorities are aware of the advantages of the early exposure of children (from primary school on) to information technologies.

SECONDARY EDUCATION

Pilot project

A pilot project was launched in 1983 at 108 secondary schools (second cycle science - General Certificate of Education, advanced level) which were equipped with microcomputers. In a second stage, the project is to be extended to 475 science schools of this level and, in a third, to 1 500 second cycle schools of all kinds. At that point the project will cover 200 000 children, i.e. about six per cent of the total school population.

A training programme for pupils and teachers has been defined within the framework of the project, by teachers already trained in computer science in collaboration with the universities and hardware suppliers. To some extent they draw on programmes developed in other countries, e.g. the BBC/NEC course.

Objectives

The objective is to familiarise pupils with the use of microcomputers. As well as the lessons, club activities are also being developed. An information letter sent to all computer-equipped schools is designed to encourage the production of simple programs by teachers and pupils.

The intention, later on, is to introduce CAI programs.

Teacher training

Teacher training arrangements are unusual to the extent that it was decided to have them organised outside the structures traditionally responsible. This decision was taken in order to maintain the innovative nature of training content and method.

Training is in the hands of university lecturers assisted by the hardware companies.

Specialised courses are given by the universities and professional associations whilst in-service training is given by computer suppliers or the users themselves.

HIGHER EDUCATION

Hardware

In 1983, the Ministry of Higher Education subsidised the acquisition of 20 microcomputers per university. In addition, donations of 25-30 microcomputers were made to some universities by computer suppliers or manufacturers. Thus, all universities are computer-equipped and some even have as many as 50 microcomputers.

The universities play the role of expert adviser on the training programme for secondary teachers and provide some of the training in conjunction with hardware suppliers.

Projects

There is a project for the creation of a local teleinformatics network linking together all the country's universities and research centres.

INFORMAL EDUCATION

There is no concerted action under this heading. There are a few computer clubs, the Open University has some computer courses and some universities organise awareness courses for adults.

Though serious economic constraints inhibit the purchase of home computers, some households intend to buy them and lessons by television will then play a part in personal extra-mural education. A club already exists, equipped and run by a community in the Colombo suburbs. Considerable hopes are placed on this type of community initiative and on the loan of hardware, coupled with television broadcasts, as a way of arousing the interest of the public in the broad sense.

Source:

- Final report of the third Asian seminar on educational technology in Tokyo. 26 Sep/2 Oct 1984 (APEID 1984).

SWEDEN

Basic data

Total school population: 1 481 800 approx. (1982)

Education budget: 54 954 200 000 Krona (1982)
as percentage of GNP: 9%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I II III IV
Cycle	Pre-school; 1 Basic comprehens. 2; 3 higher secondary
	Pre-comp.; Compulsory; Post-compulsory
	2-4 year integrated courses 22 streams Pre-univ. and vocat.
	Universities and higher studies institutes
	Colleges of education
	Adult education

	School population per level	Number of teachers per level
Primary	658 127 (1982)	40 800
Secondary	607 199	51 397
Tertiary	216 412	

Background information

1980 Completion of the DIS project whose objectives were to establish a computer appreciation syllabus and to study possible subject-related computer utilisations. The main conclusions were that:

(a) Computer appreciation syllabuses should be designed for senior level of compulsory school (grades 7-9). Instruction should be integrated in mathematics and social subjects and does not require computer equipment. Other levels were not discussed.

(b) Subject-related computer utilisation (practical illustrations of the use of computers in fields related to the subject, including subjects in vocational education) should be integrated in subjects in upper secondary school (grades 10-13).

1982 The PRODIS project (Software and Computer Equipment in Schools), whose object was to specify functional requirements for software and hardware for use in upper secondary schools, was completed. Requirements were differentiated for different subject areas and were intended to provide a basis for the purchase of equipment in the comunities and to indicate possible needs for the production of software for schools.

As part of this project, software produced by teachers and teacher trainers in applied technical courses have been collected by an advisory group and distributed to all schools with a fourth year in the technical stream.

1983 The PRINCESS project (Project for Research on Interactive Computer-based Education Systems) was completed. Princess studied whether and how teaching and learning could be improved with the use of computers as aids, where students and teachers have the initiative and control. A model of this kind of use has been developed and tested. It is of a complete system including computer assistance and its relation - for example - to teaching materials and other equipment, instructional planning and the training of school staff. Empirical studies were conducted at upper secondary level but the results could be valid for grades 7-9 in compulsory school.

A coherent programme on computers in school and adult education has been launched by the National Board of Education.

Present situation

The Swedish approach to the introduction of the new information technologies in education is a typical example of decisions taken on the basis of experimentation and research. The current programmes focus on computer appreciation courses as well as the use of computers in upper secondary school. In total activities were initiated in two-thirds of Swedish schools but there is more activity in upper secondary than in compulsory schools. Up to now there has been no marked difference in investment as between general and vocational options. There is virtually no use of computers as teaching aids. Policies are implemented through compulsory directives in curricula. The number of in-service computer-trained teachers (2-5 week courses) has increased from a few hundred to 6 000 in two years. Local communities are responsible for in-service training which can be organised locally or given as university courses. Software is supposed to be developed by producers of teaching materials and other software houses. The availability of good software needs

to be increased but so too does the readiness to acquire it for educational purposes. In all there are 9 000 computer work stations in computer schools (average nine per school with reported activity).

COMPULSORY EDUCATION

In accordance with the recommendations of the DIS report, no computer equipment for teaching computer science has been introduced at this level with government grants. The decision was made partly for financial reasons but also for reasons connected with the subject itself as no concensus exists as to the value of introducing Basic programming at this stage.

In the new compulsory school curriculum, in effect since 1982, information and discussion about computers and their effects are compulsory items in the syllabuses for mathematics, science and social science. About 50 per cent of compulsory schools at senior level report activities.

Hardware

At a rough count, all schools with informatics activities have between one and eight, generally rather primitive, microcomputers. The average is five per school.

Teacher training

A number of local initiatives have been taken to provide teachers with in-service training in computer teaching and some teachers have attended 2-3 week courses at university. The government is planning special measures for in-service training of teachers in compulsory schools for the 1984-87 period.

SECONDARY EDUCATION

Almost every secondary school (grades 10-13) has access to a computer. In general schools with technical streams have better computer equipment than others.

In 1981, about 15-20 secondary schools had minicomputers with over 100k word primary memory, each with 10-20 terminals. Additionally, almost every secondary school had 1-30 microcomputers with 16-32k word primary memory.

Computer equipment is mainy financed by the local authorities but there has been limited central government support since 1982/3.

Types of application

Curriculum - computer science

There is no specific training for computer-career pupils, they receive the same training as others.

In practice, teaching varies greatly from school to school depending on the hardware they have and teachers' skills. It is in natural science streams that most time is spent on computer science - two

hours a week in grade 2 and six in grade 3. As a supplement after completing upper secondary education, most students can choose between different courses that offer computer-oriented specialisations. Their duration is usually one year.

Curriculum - computer appreciation

As a continuation of the computer appreciation syllabus in compulsory education, computer appreciation is to be taught at grade 1 in mathematics and civics for at least 20 hours of study in all streams. Most schools were teaching computer appreciation in 1983 but not to this extent.

Due to the lack of software in schools the use of computers in various subjects is still rather limited. Also the available hardware is in many cases too primitive for such applications as bookkeeping and word processing.

Software

Production

As part of the PRODIS project, programs developed by teachers and teacher trainers in applied technical subjects have been collected by an advisory group and distributed to all schools with a fourth year in the technical stream (37 schools). A certain amount of development concerning programs for computer appreciation and subject-related computer utilisation (mathematics) is being financed by the central government. These programs are freely available to schools. Others used have been produced commercially.

Distribution

The most successful example of pooling and distributing software was in the PRODIS project. Other attempts to distribute software produced by teachers have not been very successful so far due to the unwillingness of teachers to part with their products.

Teacher training

A reform of in-service teacher training took place in the summer of 1982. Experimental activities have now been launched in which universities give compulsory school teachers three-week training courses and their upper secondary colleagues courses of a minimum of five weeks with no loss of earnings. The training is related to curriculum. Teachers from compulsory schools, where mainly computer appreciation is taught, have their courses focussed on this aspect whereas the extra two weeks for teachers from upper secondary schools also include subject-related computer utilisation. Attendance is voluntary and can be either part or full-time. So far about 6000 teachers have been formally trained.

The objective is to train all teachers responsible for computer appreciation classes at compulsory school and secondary teachers who teach mathematics, social subjects, applied technical and economics subjects and other vocationally-oriented subjects (altogether about 30 000 teachers).

Trends for the future

Based on the functional requirements determined in the PRODIS project, a technical procurement project was begun in 1982 by the National Swedish Board for Technical Development. This has resulted in a Swedish computer that will compete with other enterprises for the schools market. Five communities are involved in the project and are testing out the computer and its software during the spring of 1984 before the decision is taken on a wider distribution. The central government has allocated specific funds to the project. The total cost per annum of in-service teacher training has been worked out at SKr 50 milion.

As part of the coherent programme on computers and education, the National Board of Education has developed a policy for future work in this area. In it computer technology is to be viewed as part of a larger system and one of the goals will be to minimise gaps in society of the future, i.e. gaps between the sexes, between different groups and between parents and children. To be what it should be, education has to be up-to-date and of high quality and therefore curricula have to be revised regularly, hardware and software has to be flexible and in-service training has to aim high and be frequently repeated. For the use of computers as aids to education the pedagogical approach used in the Princess project is recommended which was not the programmed learning approach. As for the primary level, no proposals will be made before more research results are available.

Source: Document CERI/NT/84.02 (OECD).

S W I T Z E R L A N D

Basic data

Total school population: 956 400 (1982)

Education budget: 9 439 300 000 Swiss Francs
as percentage of GNP: 4.9%

Structure of educational system: Not available

	School population per level	Number of teachers per level
Primary	415 478 (1982)	
Secondary	450 372 (")	
Tertiary	90 568 (")	

Key dates in the introduction of informatics in the educational system

1973 One of the universities (Neuchatel) launches a study on the introduction of the new information technologies in education. The resulting expert report (the Banderet report) is published by the Further Training Centre for Secondary Teachers (CPS).

1975 The Banderet report is discussed at a CPS conference, one outcome of which is the decision to set up an ad hoc group of teachers (in secondary and higher education) to produce a report for submission to the supreme education authorities in the Cantons - the heads of the Cantonal departments of education.

1978 The main recommendation in the report is that a course of a minimum of 24 hours be made compulsory in all types of courses leading to the "maturité". The purpose of the recommendation is twofold: to give pupils a basic stock of knowledge as part of their general education and to develop the use of the new information technologies as a teaching aid in all subjects. The report also gives its opinion on the optimum age of the learner, i.e. pupils in their tenth year at school .

Present situation

The Swiss situation is one of widespread experimentation in upper secondary education.

1978-83 Of the 124 schools awarding the "baccalauréat" recognised by the Federation, 72 per cent offer a course in informatics. Similar courses are given in a further 22 upper secondary schools not awarding the recognised qualification. An estimated total of 12.5 per cent of the school population in "baccalauréat" and commercial schools receive a basic education in informatics. For about half of that number the courses are compulsory (one lesson a week for forty weeks). In commercial schools the frequency of lessons is higher (three sessions a week for a total of 120 lessons in a year). In these courses informatics is used, more often than not, as a teaching aid in subjects such as mathematics, physics, biology and economics.

Source: Document CERI/NT/84.02 (OECD).

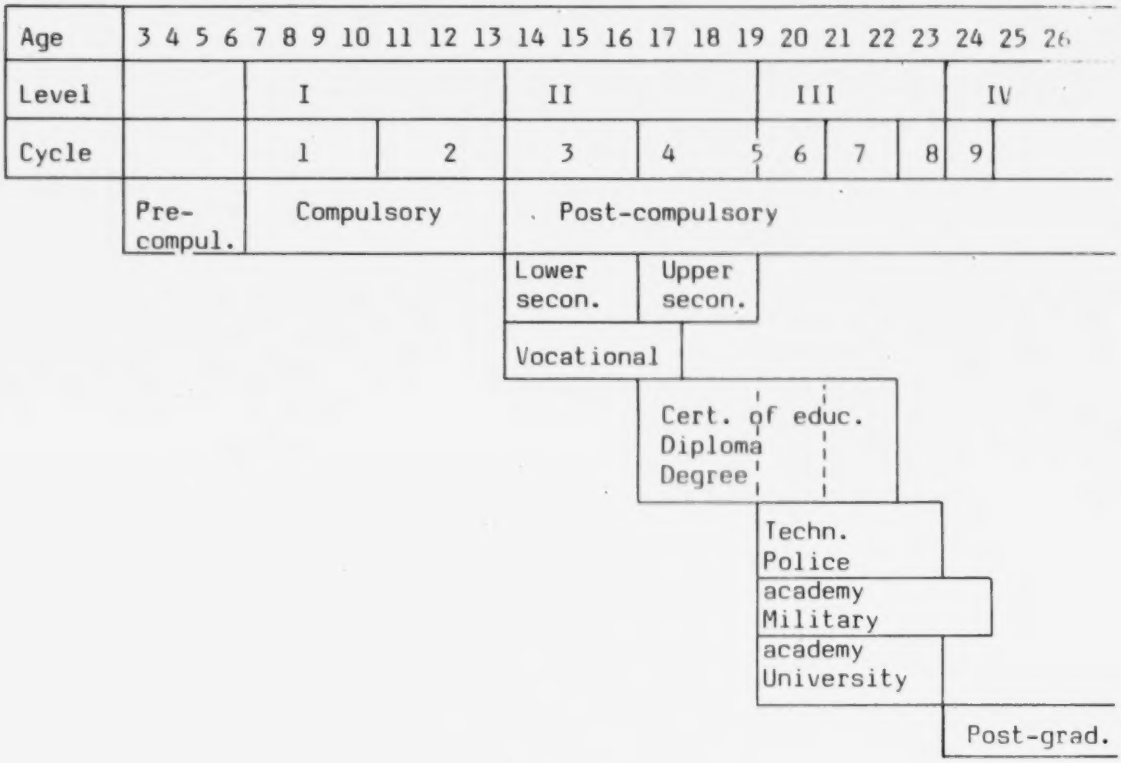
T H A I L A N D

Basic data

Total school population: 10 500 000 approx.

Education budget: 32 364 600 000 Bahts (1982)
as percentage of GNP: 3.9%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	7 449 219 (1981)	333 351
Secondary	1 990 866 (")	
Tertiary	1 056 809 (1982)	

Background

The teaching of computer science was introduced in Chulalongkorn university and the National Bureau of Statistics in 1964.

At the present time, the teaching of computer science is handled by the state universities, the private computer schools, the hardware distributors, user organisations and certain secondary schools.

One of the associations - the Thailand Informatics Association plays a central role with regard to educational applications.

SECONDARY EDUCATION (second cycle)

The Ministry of Education has recently defined informatics policy in secondary (second cycle) and vocational education. The central purpose of such teaching must be to impart an understanding of the functioning of a computer system.

The Institute for the Promotion of Teaching Science and Technology (IPST) is responsible for producing curricula and teaching materials, teacher training and monitoring and evaluation.

Two computer science courses are to be introduced in the biggest second cycle schools in May 1985.

(It is planned to introduce the teaching of informatics in primary education in the medium term.)

Teacher training

Teacher training is under the dual control of the IPST and the Ministry of Education's teacher training department. Each teacher training school has an output of 60 teachers a year. In 1985 the teacher training department is to open a two-year training cycle leading up to a certificate of qualification and to launch an in-service training programme for practising teachers.

Source: Final report of the third Asian seminar on educational technology in Tokyo. 26 Sep/2 Oct 1984. APEID 1984.

TRINIDAD AND TOBAGO

Basic data

Total school population: 260 000 approx.

Education budget: 1 034 355 000 dollars (1982)
as percentage of GNP: 5.9%

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	167 950 (1982)	6 471 (1975)
Secondary	90 363 (1980)	
Tertiary	2 503 (")	

SECONDARY EDUCATION

Hardware

32 schools are equipped with microcomputers (2 minicomputers donated by local banks and Apple II, Commodore 64 and BBC Acorn microcomputers).

Applications - Computer literacy

In 1983 the Ministry of Education, via the Higher National Institute for Scientific and Technological Research, set out the terms of an introduction to informatics project in secondary schools. 15 schools operated the programme in 1983 and 15 more in 1984. Two teachers were trained in each school by an 8-week crash course. The project is now being evaluated. By-products were a computerised time table produced by the teachers for 90 teaching staff and 1 400 pupils, a database of pupils records and scientific software.

SPECIAL EDUCATION

Two schools for children with multiple handicaps are running experiments in the use of Logo.

HIGHER EDUCATION

In Trinidad on the St. Augustine Campus of the University of the West Indies, informatics is being used for research purposes (statistical modules) by students of social science, engineering, and the natural sciences.

Management applications

The Educational Planning Unit processes demographic and economic data (projections) by microcomputer. It has also constituted computerised files using standard utility software.

The Institute of Industrial Research of the Caribbean has installed a network connected to the ERIC database.

Teacher training

A microcomputer laboratory is shortly to be opened in the Pedagogics Faculty at the University of the West Indies for teachers' use.

Software

Most software used is imported. A private association of ex-teachers has begun production of software to be marketed in the Caribbean area.

Sources: - Informatics in the education system in Trinidad and Tobago: the teaching-learning process. Paper presented at the regional consultation on informatics in Caracas, Venezuela, 1985.

- Informatics and educational administration: making optimum use of microcomputers in education. S.N. July 1985.

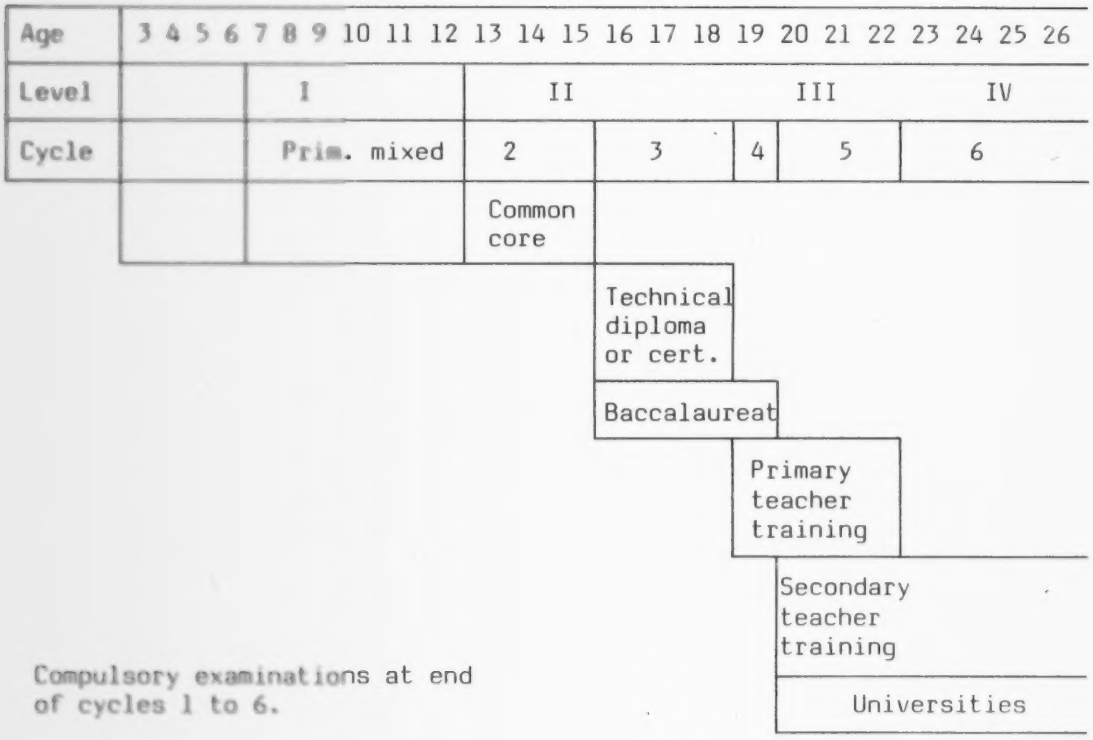
T U N I S I A

Basic data

Total school population: 1 539 818

Education budget: 253 963 000 Dinars (1982)
as percentage of GNP: 5.4%

Structure of educational system:



Compulsory examinations at end of cycles 1 to 6.

	School population per level	Number of teachers per level
Primary	1 150 580 (1982)	30 411 (1982)
Secondary	355 161 (")	18 521 (")
Tertiary	34 077 (")	4 105 (")

Applications

SECONDARY EDUCATION

- Five lycées in Tunis are taking part in a pilot project for the introduction of informatics in secondary education. The intention of the Ministry of Education is to set up computer centres in 15 new establishments.

- The early launch is also in mind of a "500 micros" operation under which microcomputers would be installed in a number of secondary and higher education establishments, clubs and young people's houses throughout the country.

INFORMAL EDUCATION

- Creation of the "Bourguiba Centre" whose purpose is to help familiarise the general public with computers.

- An agreement has been entered into by the National Informatics Centre and Radio-Télévision Tunisienne for the purchase of television programmes adapted to the Arab context and designed for the familiarisation and initiation of the general public.

RESEARCH

- The National Informatics Centre and the University of Tunis are conducting research on the arabisation of software for microcomputers.

- Creation of a Centre for Research on Informatics and Telematics (IRSIT) and proposal for the creation of CAMBIT - Centre for Research on Computer Assisted Instruction in Secondary Education.

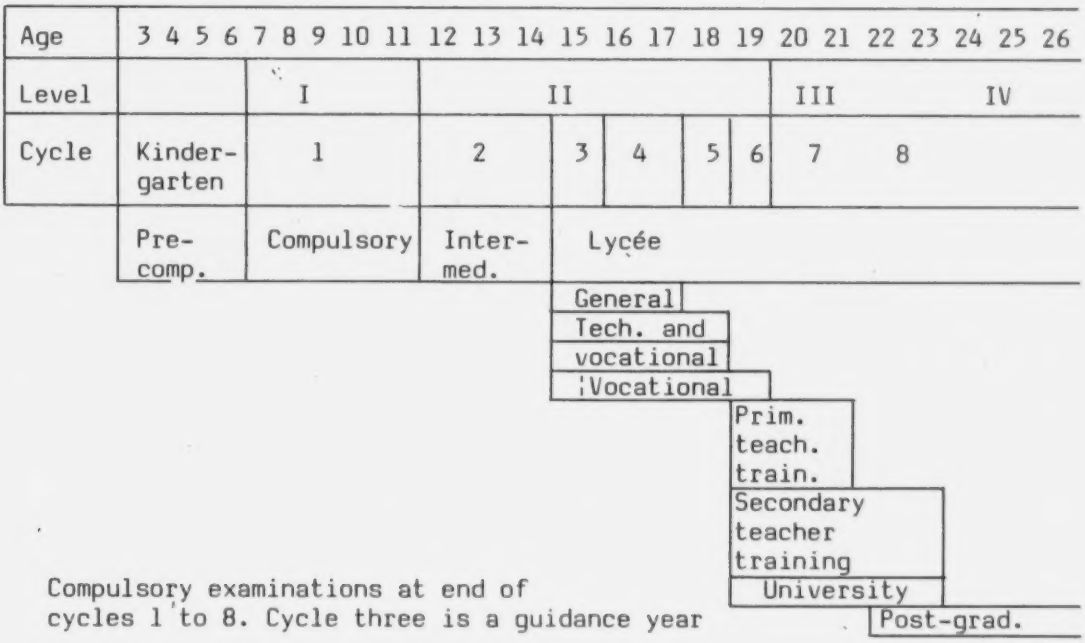
TURKEY

Basic data

Total school population: 8 535 200 approx.

Education budget: 253 575 968 000 Lira (1982)
as percentage of GNP: 2.9%

Structure of educational system:



Compulsory examinations at end of cycles 1 to 8. Cycle three is a guidance year

	School population per level	Number of teachers per level
Primary	5 859 711 (1981)	212 795 (1981)
Secondary	2 393 477 (1982)	129 268 (1982)
Tertiary	281 929 (")	21 814 (")

Present situation

The new information technologies were introduced first in the higher education establishments in the 1960s. The introduction of permanent programmes began at master's degree in 1967 followed by bachelor's degree in 1977 in the Middle East Technical University and later in Hacettepe University, Ege University, Bosphorus University and Yildiz University.

So far information technologies have hardly penetrated the schools. No policy exists for their introduction in primary education (i.e. primary plus intermediate level schools) but a development plan has been launched for the wider introduction of computer science training in vocational and technical education. The equipment of technical schools is also expected to increase.

SECONDARY EDUCATION

Hardware

One technical school has a modest computer installation. Such equipment is financed by the Ministry of National Education.

Applications:- computer science in the curriculum

Computer science programmes are prepared by the Central Organisation of the Ministry of Education in cooperation with the related universities. Computer science courses are optional. A two hours a week course is available in two secondary schools where some subjects are taught in English. Computer science programmes are also given in years 10, 11 and 12 in a "Computer science" stream opened in one technical and one vocational school. These courses run for 36 weeks (one school year).

There is a severe shortage of software. What is available comes both from universities and from producers. Its financing and distribution are covered by the relevant universities or the Ministry of National Education. Universities are responsible for software quality control.

Teacher training

Teachers are trained at the universities referred to above.

Source: Document CERI/NT/84.02 (OECD).

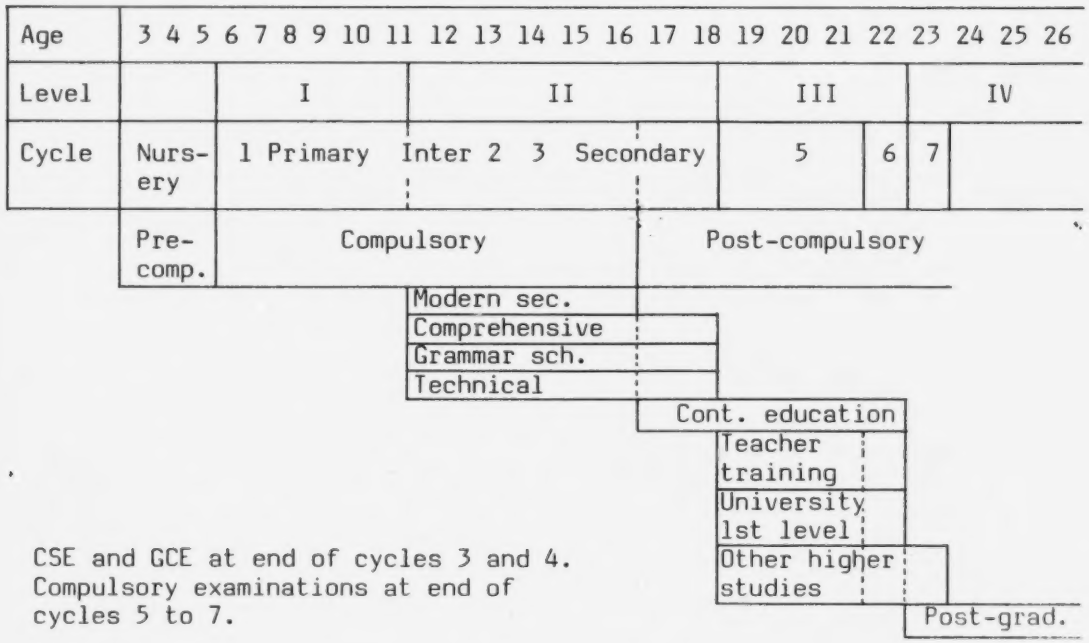
UNITED KINGDOM

Basic data

Total school population: 10 850 000 approx.

Education budget: 12 856 million Pounds (1980)
as percentage of GNP: 5.7%

Structure of educational system:



The school systems in England, Wales and Northern Ireland, like the separate system in Scotland, are highly decentralised.

Decisions are more a matter for the Local Education Authorites (LEA) than for the central government. The link between the central Department of Education and Science and the school system is the Schools Council (set up in 1964), an independent body funded equally by the Ministry and the local school authorities. The Schools Council defines curricula, controls educational research and advises the Secretary of State on the examination system.

	School population per level	Number of teachers per level
Primary	4 688 572 (1981)	250 510
Secondary	5 329 275	
Tertiary	848 000 (1982)	

Number of home computers in use: 11 per cent of households have microcomputers.

Key dates in the introduction of informatics in the educational system

1960s The interest in computer-related systems develops at first in higher education establishments.

1965 Computers are installed in schools under pressure of motivated teachers, supported by national organisations.

1970s Essentially a development decade, marked by the government-funded development programme with prime emphasis on cost-effectiveness and institutionalisation of computer-based learning, mainly in higher education (see note on NDPCAL project below).

1972 Schools across the country start developing computer appreciation courses and some, assisted by computer centres in colleges or authorities, begin using computers in different subject areas. In England and Wales a project on Computers in Curriculum gets under way. The two "Bellis" reports set the development pattern for the decade recommending, among other things, that computing as a separate subject be rejected in favour of the use of the computer in other individual subjects and that computer appreciation be taught to all pupils aged 14-16.

1979 First national measures for the introduction of informatics in the educational system. The Scottish Education Department (SED) funds the Scottish Microelectronics Development Programme (SMDP).

1980 The Department of Education and Science launches the Microelectronics Education Programme (MEP) in England, Wales and Northern Ireland.

In conjunction with the Department of Education and Science, the Department of Trade and Industry launches its equipment subsidy schemes ("micros in schools") covering England, Wales, Scotland and Northern Ireland.

More details about these national schemes are given below under the heading "project policy".

1982 The UK government announces an Information Technology (IT) programme aimed at creating new student and research posts in universities and higher education institutions and budgeted to spend 38 million pounds over three years (1983-86).

Present situation

The most important and coherent effort to introduce microcomputers to the schools of England, Wales and Northern Ireland remains with MEP. It has three principal areas of activity.

- Providing information and advice through 14 regional centres.
- Facilitating the provision of teacher training by LEAs.
- Developing materials, software and hardware for the curriculum.

In Scotland, in 1983, SMDP formally became part of the Scottish Council for Educational Technology (SCET) to be indefinitely funded with, from 1984, a national (Scottish) responsibility for a software library, information servics and the promotion of research and development in association with the Scottish Education Department and other funding agencies. The emphasis of recent SMDP work has been on software development.

PROJECT POLICY

Educational policy on information technology is defined by the central government via the Department of Education and Science, the Welsh Office and the Department of Education (for Northern Ireland) for England, Wales and Northern Ireland. Educational policy in Scotland is decided by the Scottish Education Department.

For England, Wales and Northern Ireland the project concerned is named Microelectronics Education Programme (MEP) and for Scotland the project is known as the Scottish Microelectronics Development Programme (SMDP).

Though with some differences in organisation and approach, the two projects have similar objectives:

- The initial purpose of the SMDP is to try out the use of microcomputers in primary and secondary schools including special education, further education and vocational training.

- The MEP is initially concerned with second cycle secondary schools (age 16-19) and does not include vocational training.

- In different ways the two programmes place their emphasis on the development of the use of microcomputers in curricula as a teaching aid and an incentive to introduce new features in curricula in order to bring them up to date.

  The more general purpose of the MEP is to "help schools prepare pupils for life in a society where the presence of appliances and systems based on microprocessors will be completely commonplace".

- To achieve these objectives, an appeal was made to the country's educational community for the submission of proposals and projects under the following headings:

  Courseware development in traditional subjects.

  Lesson aids for new subjects like microelectronics in control systems, informatics, word processing, consultation of data bases, etc.

  Documentation describing how to use hardware, courseware and software effectively.

  Computer applications in special education.

Concurrently with the launching of the MEP and SMDP, the Department of Trade and Industry launched a hardware equipment scheme known as "Micros in Schools".

The target in this scheme is to equip every secondary school in the country with a microcomputer between 1980 and 1982 - the choice is between two machines designed and built in UK - with the Department of Industry and Trade paying half the cost. (By the end of 1982 about 5,000 schools had bought a microcomputer).

In July 1982, a second "Micros in Schools" project was launched to fit out 27,000 primary schools on the same terms (cost shared between the Department of Industry and Trade and the school).

A feature of this equipment scheme is that the purchase of the computer is conditional on the training of at least two teachers in its use at the school concerned.

The scheme also makes provision for assistance to secondary schools to improve their basic equipment (e.g. the addition of printers and programmable robots).

General arrangements for the national schemes

Hardware

The national microcomputers selected for the MEP are the BBC Computer and the Research Machines 380Z for secondary education plus the Sinclair SPECTRUM and the Research Machines 480Z for primary education. The computers work in Basic (BBC Basic and Version 5 of Microsoft Basic for the 380Z).

In the case of the SMDP, Scottish schools were left free to decide what computers to buy. Software portability was partly resolved by a certain degree of stabilization in that a single operating system was adopted (CP/M) enabling programs to be translated (except for graphic software) for use on different machines.

The SMDP has announced (Computer Weekly of 11th October 84) that all primary and secondary Scottish schools would have at least one microcomputer by the end of 1984.

The budget (borne by the Department of Industry) for the "Micros in Schools" scheme was one million pounds for the first phase and nine million for the second (primary schools).

Software

- Production

For the MEP, courseware design is a matter of national, regional and local projects.

- At the national level structures were already operational when the programme was launched, e.g. the Geographical Association Package (created) by the NDPCAL) or the Computers in the Curriculum package of Chelsea College, London. These structures design and distribute courseware for several LEAs, the MEP bearing part of these organisations' production project costs.

- At the regional level, the MEP supports projects developed in the framework of the Regional Curriculum Development Groups representing several LEAs doing the pilot work for software production.

- At the local level, the producers are teachers working on their own or in teams. The MEP contributes financially to only a small number of projects of this type.

National production policy allows for private firms (publishers) to be involved in the production, marketing and distribution of programs.

For special education, Special Education Microlectronics Resource Centres (SEMERC) are running productional research projects in conjunction with the medical world.

The Scottish Department of Education has launched a programme for software production for primary schools with a budget of 200,000 pounds. The programme is run by the SMDP in co-operation with the local authorities.

- Languages

Most software is written in Basic (various versions). Word processing software is written in assembly language - little use has been made of specific author languages.

Although Prolog aroused a certain interest, it cannot be used in most of the computers available in schools. Logo prompted much research but the non-availability of authentic versions and the high cost of ground turtles prevented any largescale introduction of this aid in primary education.

Software produced is systematically tested in class by teachers having had no part in its development.

- Distribution

For the MEP, distribution is mainly the responsibility of the Regional Information Centres set up by the MEP on the model of existing structures such as Imperial College's CEDAR (Computers in Education and Development as a Resource)(1) or SATROS (Science and Technology Regional Education) in which author teachers and users work together and which distribute the educational software they have produced to all their members.

The SMDP has created a central software library where all the programs produced are available for consultation.

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(1) The CEDAR service discontinued activity in September 1984 leaving only CAL NEWS, a newsletter that is now distributed as an insert in the Journal of the Association of Education and Training Technolgy.

When the scheme first started, software was distributed by post on request. Later an information bulletin was issued on subscription giving a catalogue of available software and regularly updated. The system did not prove to be effective and the SMDP later formed a travelling unit to bring information to schools and collect information from them on how the scheme was working.

Teachers

The MEP scheme includes provisions for teachers, stating that the needs are:

- To inform teachers about developments in computer applications.
- To train teachers in the effective use of computers in class.
- To produce materials that can be used by teachers and to study the effects of introducing computing in curricula.

The MEP is continuing and developing (but re-organising) the training given during the NDPCAL project (see below). The content of the training is focussed in three main directions:

- Microelectronics (integrated circuits, microprocessor architecture, etc.).
- The art of using a microcomputer as a teaching aid.
- Computer science (general computer science, analysis, programming methods, etc.).

The training is organised from a network of Regional Training Centres. There are 14 regions into which the 97 LEAs are grouped. In each of the regions, four training centres organise different types of course:

- Introductory courses of 1-3 days or part-time equivalent.
- Familiarisation courses of 1 week for teachers motivated by the introductory course.
- Courses for specialists lasting up to 3 months for teachers seeking to deepen their knowledge or wanting to produce courseware.
- Courses for trainers of teachers at refresher courses for LEA educational advisers who then organise teacher training sessions in their own areas.

The training centres also provide distance education courses for teachers given by the Open University, the BBC and the National Extension College (NEC). Computer science is also being gradually brought into initial teacher training.

In the original MEP scheme 60,000 of the 150,000 pounds allocated annually to each region were to be reserved for teacher training. The intention was that this would give 2,400 teacher-days per year per region.

The SMDP scheme formed Computer Training Centres in 4 of Scotland's 7 Colleges of Education. The tasks of these centres were defined as follows:

- To offer initial training courses on computing and computer applications in various disciplines.
- To offer continuous training courses in computer science and related disciplines.
- To supply a computer back-up service to all colleges and local schools (in the field of the curricula).
- To set up an advisory centre on computer science and microelectronics in general.

Cost

When first brought out, the MEP scheme had 9 million pounds at its disposal for five years spread over the following items:

- Staff recruited to put the MEP into effect.
- Support for selected projects.
- Support for the regional training centres.
- Support for the regional information centres.

This budget was only to cover central costs and does not include expenditure by the schools themselves - met by the LEAs (staff costs in particular).

When the Scottish programme was launched its cost was put at 5.4 million pounds over 4 years:

- 2 million pounds was the MDP programme contribution and
- 3.4 million pounds was the regional contribution.

Per year, therefore, the average cost was 1.35 million pounds.

The regional contributions did not include staff costs (teacher training) and the total budget did not take into account the contribution from the Department of Industry (hardware).

PRIMARY EDUCATION

Hardware

As at December 1983, 43% of schools were equipped with 1-2 microcomputers, mainly BBC, but with some Sinclair Spectrum and RML 480Z. With the implementation of the scheme from the Department of Trade and Industry the figure will continue to increase rapidly to above 90% by 1985 (this is the figure given by the OECD. Another source - Screen Digest of December 1984 - refers to a figure of 27% of primary schools equipped).

In the field of special education, research has been carried out in the Special Education Microelectronics Resource Centres (SEMERC) on adapting machines to children's needs and capacities and the use of terminals with tactile screens is being considered.

Computer equipment and peripherals are mainly financed by central government funds (in particular under the Micros in Schools programme), matched by schools with extra equipment obtained via school funds or gifts.

Types of application

Computer science does not feature in the primary curriculum as a "subject" and no special provision exists within the primary curriculum for computer awareness as such. However, children are familiarised with the problems of computerised society through topic work covering language, arts and environmental studies.

The types of use of software are extremely varied: assistance and support programmes, simulation, problem-solving, games of adventure, and first lessons in arithmetic, language and writing, etc.

Some programs are designed to familiarise pupils with data processing and data bases (but to a lesser extent than in secondary schools). There are also word processing programs for primary schools.

(A first package of some 30 programs was supplied to schools acquiring microcomputers under the Department of Industry's Micros in Schools scheme.)

In special education, computers are largely used for basic education (reading, writing and arithmetic, sensorial education, mental co-ordination, etc.).

Software

Production

Much of the software is written by teachers, some secunded to software production units.

The SED has a primary schools software production project via the SMDP and there is a further DTI project with material appearing via authority-based and college-based groups.

As intended in the MEP, some software production now comes from private publishing firms and the use of these commercially available programs is spreading. Production costs in this case are wholly met by the publishers.

Quality control and evaluation

There is no formal agency officially responsible for software quality control. Some education authorities have formed evaluation groups of teachers and advisers which link with MEP and SMDP. These are seen as focusses for documentation and production standards.

Software is generally available in several versions for use on the range of hardware laid down in the DTI's equipment scheme.

Distribution

(See MEP and SMDP distribution arrangements above).

The current trend is for schools to buy commercially available software out of their own funds but the total amount of software available is still less than effectively required.

The downloading of software (by cable via PRESTEL or by radio) is beginning to be adopted but far less significantly in primary than in secondary schools.

Teachers

In Scotland initial training in computer appreciation is given to all students with the additional option of more specialised training (implications of computers, their use within the curriculum and, normally, some programming). In addition, as we have seen, the Department of Industry's equipment scheme required every school concerned to give in-service training to at least two teachers in the use of computers. About 10 per cent of teachers are estimated

to have taken these courses or the increasingly numerous courses offered by the school authorites and teacher training schools. Some teachers have taken longer courses in higher education (e.g. via the Open University. Such training may be part or full-time but is always optional.

In the United Kingdom and Wales MEP have a unit to support teacher education. In Scotland a development plan to extend in-service training further is under consideration in conjunction with the software developments.

SECONDARY EDUCATION

Hardware

By December 1984 virtually all secondary schools (97%) had microcomputers with an average of 5-10 used by at least 4 members of staff. Some schools have more than 50. The most frequently used machines are the BBC computer and the Reseach Machines 380Z. Tape-type peripherals are tending to be replaced by disc drives.

The use of micros as presentation devices is growing as better graphics capabilities have become available. Interface development is also bringing changes in the use of computers. Individual teachers are experimenting with modems for telesoftware and electronic mail. Interactive video is also being used in some research contexts.

Apart from the hardware supplied under the Department of Industry's Micros in schools scheme, all microcomputers have been bought by education authorities or schools out of their own funds.

Networks

The Council of Educational Technology (CET) and the Scottish CET both run public databases via Prestel. The CET operates in association with Prestel. It piloted telesoftware distribution and is developing an education service. This project known as the Prestel Education Service is intended for the 7 500 English secondary schools and involves the MEP and the SCET. It was worked out in close collaboration with British Telecom - the operator of the Prestel network - and the Department of Industry and Commerce. The launching of the service has been announced for January 1985. It will partly focus on microcomputing with School Link set up in association with the magazine Educational Computing. School Link enables educational software to be downloaded.

Information on school career guidance is the other focus of Prestel Education Service activity. Later it will be possible to request, on-line, printouts of additional information. With regard to the hardware, the strategy differs from the microcomputer scheme (in which schools and DTI share the cost). Here the CET and the DTI have invited bids for a modem, communications software and Prestel emulator, the hardware and subscriber fee being presented at a discount thanks to the grants made by the DTI. These grants are scheduled to total 50,000 pounds for the first two years (1985 and 1986).

The Scottish CET also operates a private viewdata system. This is being used for electronic mail and interactive communication by schools in parts of Strathclyde region on an experimental basis. It is also the focus for a DTI-supported electronic information exchange among teachers in special education establishments.

Centrally-funded projects using databases or electronic exchange include the creation of databases, computer-assisted careers guidance, SCAMP (for school administration), geography data and the Educational Broadcasting Database in conjunction with the British Broadcasting Corporation and the Independent Broadcasting Authority.

Few schools will have contact with major public databases such as BLAISE and ERIC, except via colleges or libraries.

Types of application

The variety of applications is extremely great with utilisations ranging from the support program to the interrogation of databases via CAI, simulation, modelling, decision-making, word processing, etc. A point to stress here is the importance assumed by word processing and documentary programs used by teachers to develop pupils' ability to manage information in a method based on the learning process rather than on curriculum content.

In the more traditional approach, however, the computer is mainly used in mathematics, science, geography, modern studies, modern languages and in remedial education, but there are developments in course content and in the use of micros to support teaching in most subjects, and increasingly so. The over 500 programs developed via MEP and SMDP are primarily aimed at assisting learning and teaching across subjects.

Electronics and microelectronics have been introduced as new courses or subject elements, with associated software, and associated use of interfaces and programmable peripheral devices.

An example of a major project is the one at the Esme Fairbairn research unit (Heriot Watt University) which involves a simulation of the British economy. This is used for teaching macroeconomics in the final year of schools and in universities. It forms the basis of a UK-wide competition for schools and has been adopted as a teaching package by a range of large oil, electronics and shipping companies.

Educational management

Some research projects are aimed at developing courseware packages for assessment (achievement testing, for example).

Administrative management

The Schools Computer Administration and Management Project (SCAMP) will enable all educational authorities to provide from a single database housed in a powerful micro all the administrative needs of a secondary school. It is being developed at SMDP and tested in several authorities. Smaller scale, interim, administrative support programmes are being produced by interested schools and by authority centres.

Curriculum - computer appreciation

"Computer Studies" courses, covering awareness, applications, uses and effect on society have a history going back over 12 years. They do not have a vocational emphasis but include programming skills and are being provided increasingly, but to differing degrees, for pupils aged 12 and over. In Scotland a recent set of curriculum guidelines for courses for the first two years of secondary education (ages 12-13) have had a significant effect on course development.

Computer clubs are extremely popular in schools and offer access for pupils of all ages at intervals during the day and after school, though mainly by boys.

The political, sociological and psychological problems of computerisation in society are considered in a number of social subjects courses, courses related to the industrial society and in business studies.

Curriculum - computer sciences

No distinction is made in provision between pupils wanting to take up computer-based careers and others.

Examinable courses in computing have developed in different ways across the UK at the 16+ examination and higher levels. In England and Wales there was a substantial growth in numbers taking these courses in the last decade. Exact future arrangements are not clear, given the planned re-organisation of 14-16 age group courses and changes at 16+. In Scotland the Action Plan provides several "modular courses", opportunities in computing, some of which will probably be used in schools and which relate directly to post-school training wherever provided.

Software - production

The computer education centres in the Colleges of Education, and in education authorities, which have existed for several years, have moved quickly into adapting their work and packages for micros. Some of this is in conjunction wih MEP, SMDP and curriculum development projects. Teachers have been secunded and provided with programming support. Some commercial software is available.

MEP allocates sums via its regional centres to encourage and develop software production from schools and colleges. There is also a considerable amount of "cottage industry" programming by teachers. Education authorities support a range of smaller centres, building upon the activities of subject-related teacher groups. A DTI software development scheme will provide further subsidised production at UK level.

Software - quality control and evaluation

Although there is no organisation formally responsible for controlling software quality, MEP/CET and SMDP perform this function and have issued documentation and programming standards. Local teacher evaluation groups exist with specific subject interests. Most centrally-funded software is made available in at least two formats, usually BBC Basic and Apple, Sinclair Spectrum or RML 380Z-compatible.

Software - distribution

MEP operates regional centres and SMDP, in association with education authoritie and coleges, operates a system of distribution centres for its software. Commercial publishers are providing a growing amount of material.

Schools are begining to experiment with telesoftware distribution via Prestel and through the BBC broadcast teletext CEEFAX service in association with school broadcasts (see under "Networks").

Teachers

Pre-service training: voluntary training courses in computers are offered to almost all trainee teachers but the arrangements differ across the United Kingdom. In parts, e.g. in Scotland, compulsory courses are generally given to teachers of mathematics, business studies, sciences, geography and other social subjects (covering computer appreciation and the effect on their subject). All such courses are provided by teacher education colleges. The number of hours given can range from 30 to 300 depending on the subject. The number of teachers being trained in this way is declining as recruitment to teaching reduces.

In-service training: under the DTI equipment scheme two teachers per school underwent short courses of training. Further provision here is by education authorities alone or, more usually, through colleges of education and, in England and Wales, in association with MEP. Training is voluntary and would normally consist of hand-on experience, introduction to programming and the application of computers in specific subjects. There have been some subject-based courses. Beyond these, establishments are providing more advanced courses in computer studies, computer-based learning, electronics, control technology, communication and information systems. Some of these are in association with MEP.

The number of teachers involved is increasing and totals more than 40 000. The trainers are college lecturers or education authority staff recruited from practising teachers. Development plans for this area of training are under study and further staff in computing are being recruited for colleges.

TRENDS FOR THE FUTURE

In England and Wales the MEP will continue to support LEAs and schools in their information and teacher-training functions until 1986. Thereafter LEAs will be expected to take over and run these actyivities. No decision has yet been taken on whether there will be continuing support from the MEP for software production after 1986.

CET is continuing to put a major part of its exploratory work into the new technologies, including interactive video(1).

In Scotland, SMDP is now on a permanent basis as part of SCET and is providing a national centre for support of software development and distribution, information and the promotion of research and development.

The Alvey report and research council recommendations are expected to influence the increased interest in research in microcomputers and the curriculum at UK level.

Other enquiries, including in association with MSC-funded developments, cover the increased use of other individualised and open learning approaches and media as a consequence of the other changes in curriculum and assessment for the 14-16 age range and the 16-plus students (including adults) not in higher education.

In addition to supporting the work of the SMDP, the SED is funding a range of research projects in primary and secondary education including the effects of school building provisions, and their use, on the introduction of the new technologies.

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(1) On 7 Nov 1984, the BBC launched a country-wide project for a videodisc database on local and regional communities in the United Kingdom. The idea is to commemorate the 900th anniversary in 1986 of the Domesday Book in which William the Conqueror ordered that the country's whole population be registered.
The discs will be used on a new videodisc reader now being developed by Philips enabling video documents, text and computerised data all to be stored on the same medium. The volume stored on the discs will be equivalent to two sets of the Encyclopaedia Britannica, i.e. two million pages of information, 20 000 land-use plans and nearly 150 000 diagrams and photographs.
The whole population will be involved in the project to collect the information required. Early in 1985, 10 000 schools with ACORN (BBC) microcomputers wil receive pre-formated diskettes on which to collect data on the population and geography of their area. The information collected by pupils will include population and land-use statistics, maps, photographs and text. The MEP is involved in the programme alongside scientific institutes, universities and municipalities.
The cost is being borne by Philips UK and the Department of Trade and Industry. The BBC is project leader and will be responsible for the distribution of the final product.
The British Government intends to meet half the cost of videodisc readers purchased by schools to be able to consult the discs they will have helped produce.

HIGHER EDUCATION

The British scientific community, aided by the administrative structures, active on this type of problem since 1973, will by 1985 have the use of a national computer network for purposes of public research under the supervision of the Department of Education and Science.

Called the Joint Academic Network (JANET), the project will link up 150 university computer stations for the exchange of information in the form of electronic message transmission and teleconferencing.

The nucleus of the network is SERCnet, a network set up earlier by the British National Council for Scientific and Technical Research. JANET uses a combination of dedicated lines and British Telecom's public data transmission network PSS.

University centres with all kinds of computer equipment will be able to communicate with one another thanks to the high level of standardisation introduced based on the X 235 and OSI (Open System Interconnexion) protocols.

The network will be largely financed by the Computer Board, a national body under the Department of Education and Science and because of that use of the network will be exclusively reserved to the scientific community working on research covered by that Ministry's budget. Users will therefore be universities and state-financed laboratories and institutes, plus members of polytechnics and continuous training centres.

(Pro mem)

NDPCAL PROJECT (1973-1978)

(National Development Programme in Computer Assisted Learning)

In 1973, the Department of Education and Science decided to allocate 2.5 million Pounds on developing the educational uses of computers. A slim structure was set up around a Programme Committee responsible for selecting projects submitted for financing, primarily computer assisted instruction projects and computer-based educational management projects.

In order to ensure the survival of the projects beyond the period covered by the NDPCAL programme, institutions entering projects had to undertake to meet half the cost.

During the Programme 17 CAI projects were launched, 9 in higher education, 3 in secondary schools, 2 in vocational training and 3 in the armed forces.

The most interesting projects(1) are those of the higher education establishments (universities and polytechnics) to the extent that they are inter-institutional (29 institutions being involved in the nine projects by the time the project came to an end). They involved the writing of over 450 programs (mainly in Fortran, Basic and spcial auther languages) by teachers in conjunction with professional programmers paid out of special NDPCAL funds.

Actual use of the terminals by students fell short of the forecast made by the NCET (National Committee for Educational Technology) when the programme was launched, i.e. 2 000 hours a year per terminal. The actual figure varied with establishment between 150 and 500 hours. The total count for all students in 1976-77 was 35 000 hours of use.

A significant proportion of the projects initiated by the NDPCAL in the CAI field continued beyond the programme itself.

In the educational management field the most important development arising out of NDPCAL is the Camol program (Computer Management of Learning) originally developed by the ICL company. Two applications of this program were operated by Ulster University (in a course on curriculum design) and Brighton Polytechnic (educational management of 600 students enrolled annually).

The distribution of software was handled by two small institutions subsidised for the purpose by the NDPCAL, the Physical Sciences Program Exchange (PSPE), which distributed small physics and chemistry programs (at about 10 Pounds each), and the Geographical Association Package Exchange (GAPE) responsible for collecting, testing and correcting programs and then distributing them via regional centres set up in higher education establishments for onward distribution to local schools.

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(1) The 3 secondary school CAI projects present no special interest because the computers were used for survey analysis and the projects totalled only 6 per cent of all NDPCAL grants for CAI projects.

The total cost of the programme, given the requirement on institutions to co-finance the projects they proposed, was about 4.5 million Pounds (2.5 million coming from the NDPCAL), breaking down as follows:

- Hardware (computers, terminals):	400 000 Pounds
- Project teams salaries	1 600 000
- Travel	100 000
- Miscellaneous	400 000

About 1 million Pounds was spent on hardware by the institutions producing the projects.

One of the programme's objects - to introduce innovation at relatively low cost - could not be verified by the financial analysis of the projects because the methods of measuring cost-effectiveness proved inapplicable in the case of CAI (non-quantifiable results), the projects showed widely varying unit costs (from under 5 to over 20 Pounds per student/hour) and in every case CAI was an additional cost in relation to the teaching methods in use in the pilot establishments.

Sources:

- Document CERI/NT/84.02 (OECD)
- The United Kingdom context for the application of microcomputers in the teaching-learning process. (SLND).
- Computer education in developed countries. Methods, achievements and problems. (J. Hebenstreit), Unesco ED-84/WS/10 September 1984.
- La formation des formateurs à l'utilisation des micro-ordinateurs dans l'enseignement secondaire à partir des expériences française et anglaise. (B. Dubreuil). Unesco ED-83/WS/11. July 1982.
- ANTEM letter No. 0 (October 1984) and No. 1 (November 1984).

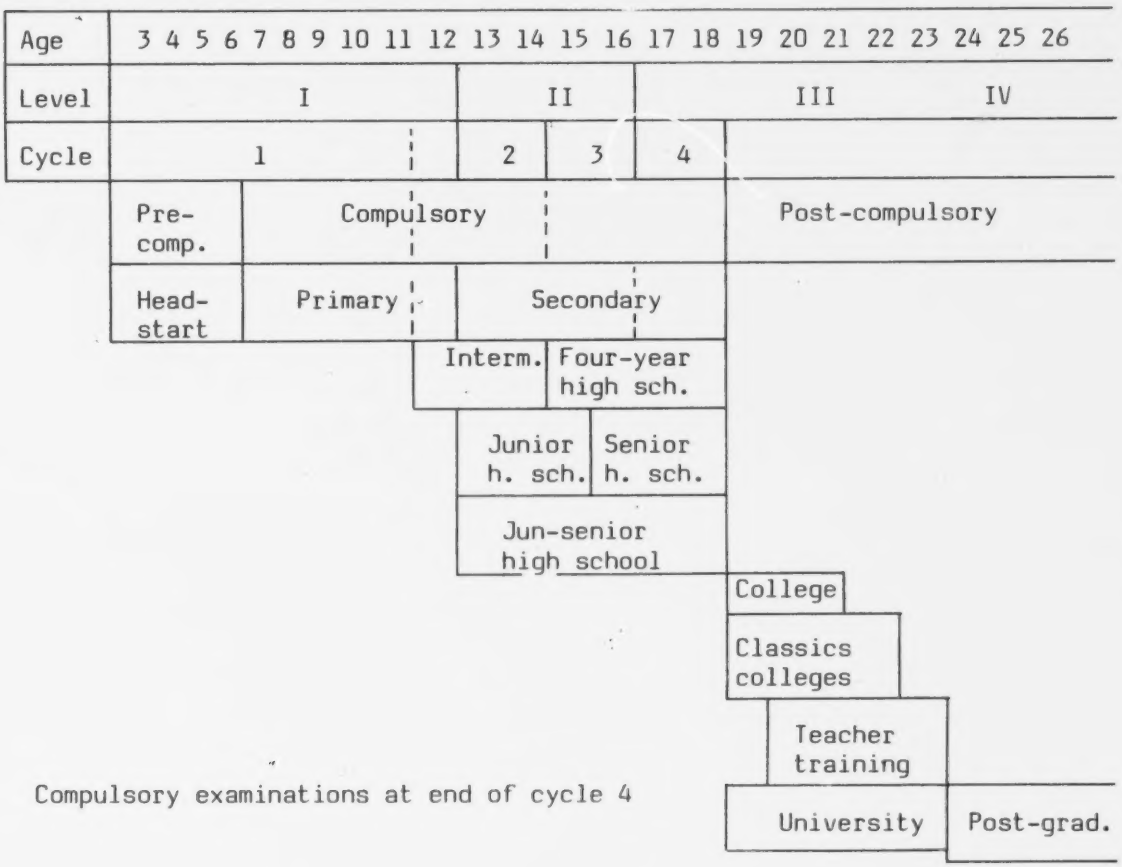
UNITED STATES

Basic data

Total school population: 54 800 000 approx.

Education budget: 199 800 million dollars (1981)
as percentage of GNP: 6.8%

Structure of educational system:



Compulsory examinations at end of cycle 4

	School population per level	Number of teachers per level
Primary	27 794 000 (1981)	2 390 000 (1981)
Secondary	14 643 000 (")	2 390 000 (")
Tertiary	12 371 672	395 992 (1980)

Background information

The current trend in US federal involvement in education and the new technologies can be traced back to the general development of federal policies and intervention in science and technology. The trend has been essentially cyclical. It started towards the end of world war I with the Bush Report (Science - the endless frontier) establishing the development of scientific talent as a federal responsibility. Aimed first at identifying the "talents" in higher education establishments (the federal programme of grants and fellowships to students who had already chosen a science career) the policy approach changed subsequently from aid to the already visible talents to large scale research and development of the science potential within the population. Federal intervention then took the form of teacher training programmes and curricular changes at high school level (Grayson, 1981):

1965	36 per cent of relevant educational funding came from federal sources;
1970	The financial volume fell to 17 per cent;
1980	Federal participation falls even lower.

Current situation

The federal interest in the field is at present rising once more. The target is as before the reservoir of scientific talent within the population. The concern is with the education of an adequate number of specialists for the economy of the very near future.

It is too soon to see what specific forms the renewed federal interest in education and the technologies will take. The US situation for the time being remains profoundly marked by initiatives at the state level. One federal initiative in recent years, taken in 1982, was the "Technology initiative" whose objectives included a study of the implications of introducing computer science into curricula. Federal funds are also allocated to projects for the training of those responsible for education in the States. Two examples of assisted activities are the Association for Educational Communications and Technology and the SLATE (State Leadership Assistance for Technological Education) and VIM (Videodisc Interactive Microcomputer) projects, the last-named being a network linking 45 schools together and using videodiscs and microcomputers.

A federal body, the Office of Educational Research and Improvement (OERI), also finances research projects such as QUILL (use of microcomputers for learning to write in primary school.).

Number of computers in use

The number of microcomputers that children in the public schools have for their use increases threefold every 18 months.

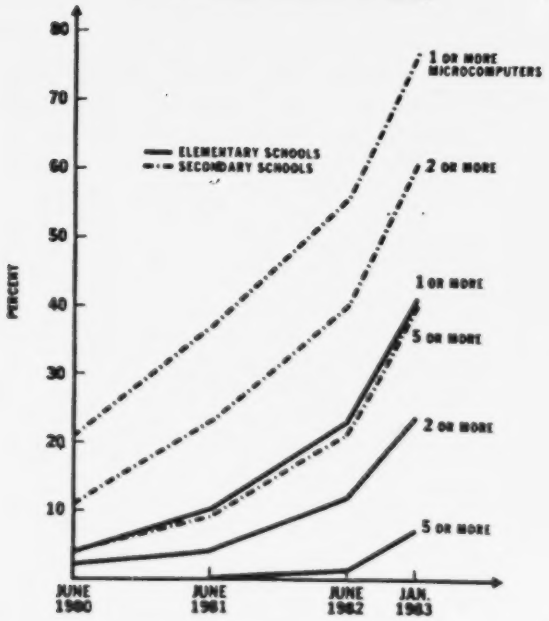
In 1983 it was estimated at 325 000 (source 1), 333 000 (source 3) and 500 000 (source 2); some observers (source 1) put it at over a million (a figure others advance as the likely total in schools in 1986).

In January 1983, 60 per cent of all schools in the United States had at least one microcomputer. The figure for secondary schools was considerably higher but the gap between primary and secondary is closing.

For the year 1983/4 the equipment budget for primary and secondary schools throughout the country is estimated at 188 million dollars. The average cost of a microcomputer bought by a school lies somewhere between 1 000 and 2 000 dollars.

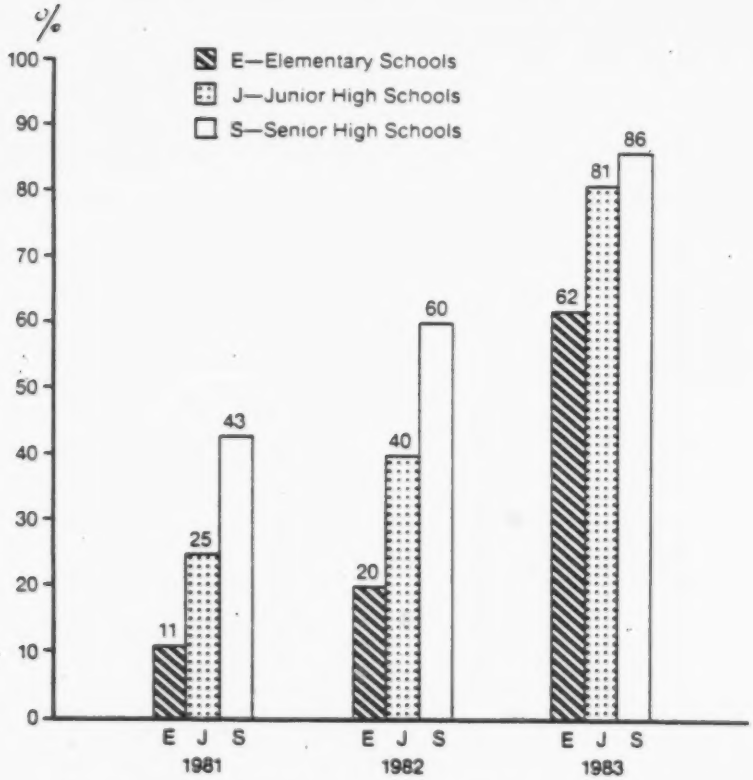
There is expected to be one microcomputer for every 23 pupils in the United States by 1987 (compared with one for 92 in 1984).

UNITED STATES SCHOOLS WITH MICROCOMPUTERS



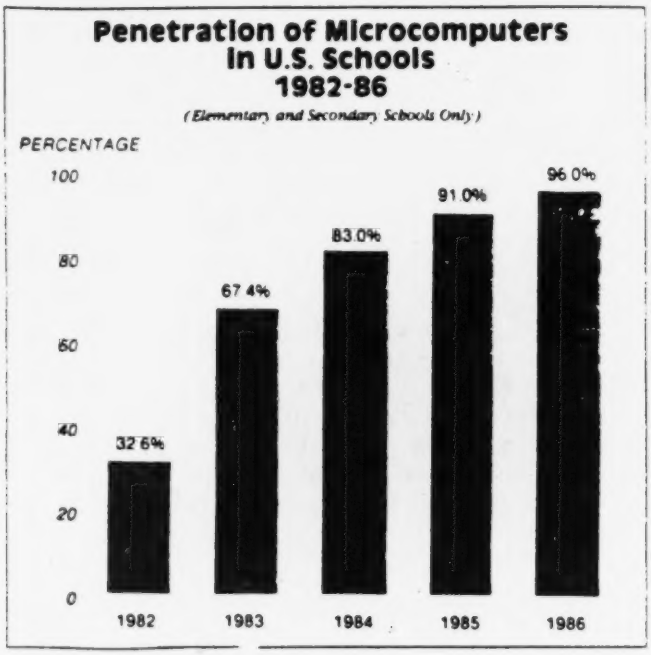
(Source : Grayson / Overview of Computers in US education - In : T.H.E. Journal Vol.12 N°1, August 1984)

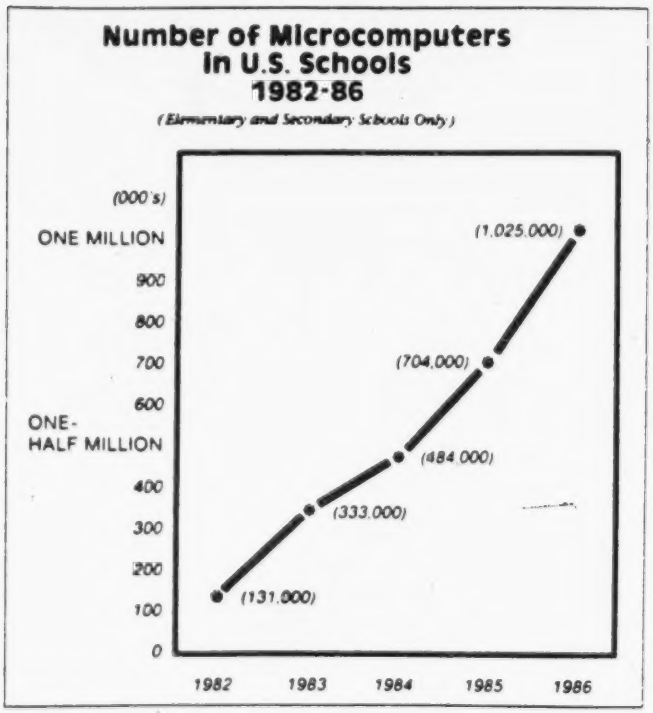
GROWTH OF USE OF MICROCOMPUTERS IN SCHOOLS IN THE UNITED STATES, BY SCHOOL TYPE



Source: Market Data Retrieval, Westport, Connecticut
Used by permission.

(Source : Ingersoll and Smith : Availability and growth of microcomputers in American schools - In : T.H.E. Journal - Vol. 12 N°1, August 1984)





PRIMARY EDUCATION

The objectives pursued include:

- Improved student learning;
- Improved teacher preparation;
- Improved student preparation for modern workforce.

Hardware

Sixty per cent of US primary schools have at least one computer and of those seven per cent have five or more.

Because of the decentralised nature of the educational system, schools and local communities have complete freedom to decide whether to buy computers and if so what kind to obtain to meet what they feel to be their needs.

Several school districts have set up technical assistance centres to help directors and others responsible for schools in their choice of hardware. Demonstrations of machines and software are given in these centres. One such centre is that set up by the State of Minnesota, the Minnesota Educational Computing Consortium (converted into a private business), which evaluates and distributes programs and also buys and distributes many thousands of microcomputers to education establishments at all levels. Similar service are offered by other centres such as the Houston Independent School District, the New York State Centre for Learning Technologies and the Educational Collaborative Center of Greater Boston.

Computer purchases are financed by parents associations, foundations, private businesses, the local authorities and, more rarely, the States although 10 States and the District of Columbia each allot over one million dollars to school equipment and training in primary and secondary schools.

Types of application

Unlike the secondary schools where the aim is to give each computer-using student as much machine time as possible (which reduces the number with acces to the computer), the policy in primary schools is to make access as general as possible which means that each pupil has very little time with the computer.

In primary schools computers are used an average of eleven hours a week (just over two hours a day) but practice varies greatly from school to school: one out of seven claims that every computer is used more than five hours a day but a quarter of primary schools use their hardware only one hour a day. In a typical primary school, 80 per cent of the pupils have access to a machine less than 30 minutes a week; one out of fifty has over one hour's access a week.

Forty per cent of the time computers are used is taken up with the use of programmed exercises in mathematics, language, spelling and memorising, one third on composition, writing and program evaluation and the remainder on educational games.

Software (1)

Software is produced by private firms (there are about 750 program producers) and sold to schools. The number of programs on the market runs into thousands, written for the most widely used computer brands, particularly the IBM-PC. A high percentage of these programs are of poor quality. Some commentators say that 95 per cent of those put on the market should never have been produced. Out of the 20 000 programs currently available only 10 per cent have been seriously evaluated.

With the market for computer hardware in schools growing swiftly, firms are increasingly interested in the software side. They include names like IBM, Control Data Corp., Apple and Commodore, publishers like Addison Wesley, Ginn and Co., Random House, McGraw Hill, Scott Foresman and Co., etc., and entertainment businesses like Walt Disney and the Childrens Television Workshop. It is hoped that this mass invasion of the software market will improve the quality of the programs.

In the field of program evaluation, some public establishments provide selection assistance. The Northwest Regional Educational Laboratory, for instance, has set up an information centre known as Microsift on programs for use in schools from kindergarten to the end of senior high. The centre collects and evaluates programs and then issues critical appreciations to teachers. For this purpose it has the use of a database run by the Bibliographic Reference Service.

Another institution, the Educational Products Information Exchange assesses software and trains teachers in evaluation.

Lastly a national reference centre has recently been set up which operates both as a database enabling software to be selected that meets specific needs expressed by teachers and as a software library where over 21 000 products can be tried out on the spot by users.

Very few computer activities at school are the subject of assessment. Some results of research in primary school show the effectiveness of the computer used to back up conventional teaching methods.

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(1) The programming language "Smalltalk 80", one of the most powerful object-oriented languages developed, facilitating man-machine dialogue and on which the diminishing menus and the use of icons and mice now found on many microcomputer terminals were based, was developed in the framework of Dynabook, a 1970s project for the design of a portable, flat-screen, school microcomputer which did not come to anything.

SECONDARY EDUCATION

Hardware

83 per cent of all high schools have at last one microcomputer and of those 40 per cent have five or more. Because of the decentralised nature of the educational system, schools and local communities have complete freedom to decide whether to buy computers and if so what kind to meet what they consider to be their needs.

Computer purchases are financed by parents associations, foundations, private businesses, local authorities and, more rarely, the States, although 10 States and the District of Columbia each allot over 1 million dollars to school equipment and training in primary and secondary schools.

Types of application

Unlike the primary schools which prefer to give access to the computer to the largest possible number of pupils (and therefore for only short times), the high schools aim at longer times with the computer for a smaller number of pupils.

On average, microcomputers are used 13 hours a week in secondary schools but practice varies widely since 20 per cent of them say that computers are used over five hours a day. Against that, one fifth of schools use them only one hour a day.

In a typical secondary school, the majority of user pupils have over 45 minutes access to a machine each week. Two out of five have over one hour with a computer per week.

Programming and computer literacy account for two thirds of the time allowed for pupils' use of computers. Repetitive exercises and practical work take up eighteen per cent and the remainder is spent on educational games, word processing, laboratory work and management courses.

In principle, schoolchildren are given the introductory computer course in grade 7, 8 or 9 at the rate of three hours a week for twenty weeks. The course includes general information on the computer and programming.

The use of microcomputers for teaching mathematics, sciences and foreign languages is spreading as better software becomes available and access to it easier.

Teaching of informatics

States differ in their insistence that computer education has to be introduced in schools. In 1983 only three (Florida, Rhode Island and Virginia) plus the District of Columbia had legislation making the teaching of computer techniques compulsory in secondary education. Two others (Indiana and South Dakota) urged schools to provide optional courses for their pupils. Twelve States (Arkansas, Colorado, Delaware, Hawaii, Minnesota, Nevada, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania and Texas) are content to "recommend" schools to give computer lessons but do not make this compulsory.

Computer science varies widely in content and number of hours of instruction. Enrolments in college-preparatory courses in computer science are growing with growth in demand by business and industry. An advanced placement examination is now available as part of the College Board Admissions Testing Program.

Software

Little software has been funded or produced by State or local education agencies; some has been produced by university faculties funded by the federal government; little has been produced by teachers and pupils. Most is now produced by private sector firms.

The quality of presently available courseware is generally poor and although software compatibility is a problem for the schools there is no systematic effort to solve it. Operating systems such as CP/M and run-time hardware interpreters and emulators represent partial solutions now in use. It is anticipated that this rapidly developing technology will evolve new solutions in the future. Until then, rewriting software as necessary is likely to be the solution of choice for software developers.

Teacher training

Even States where schools are not compelled to teach computer science have arrangements for teacher training. In 1983 16 States made the initial or continuous training of teachers in the use of computers a varyingly firm requirement and 20 were considering so doing. A working group was set up by the Association for Computing Machinery to define training content and methods for teachers giving computer instruction. The group's recommendations were scheduled for publication in the spring of 1984.

Teacher training is available at specialised centres, adult education services in state universities, private universities in the framework of summer school, other higher education establishments, local school authorities and computer manufacturers (Apple, Atari, Tandy, IBM, etc.).

Support agencies

Various regional (state) or federal agencies have been set up for the purpose of supplying schools with hardware and software and specialise in either of these two activities.

- The Educational Computing Consortium of Minnesota (MECC): this is a network of small and large computers linked to terminals installed in state secondary schools which, more recently, have equipped themselves with microcomputers used as terminals. The project is partly financed by the National Science Foundation and the State of Minnesota and concerns some 800 000 secondary schoolchildren.
  In addition to access to the network the MECC services include facilities for hardware purchase, a library that loans out educational software and training facilities for practising teachers.
  Some 77 associations in 34 states, several Canadian provinces and some foreign countries have joined the network since 1982.

- The Conduit Consortium in Iowa. This project brings a dozen universities together in the production and distribution of low-priced educational software (programs costing 10-50 dollars). The interest of the project lies in the fact that Conduit submits the programs to CAI experts for approval and distributes, on a selective basis, only those products (British and American) that have been passed.

- The Computer Uing Educators (CUE) set up in 1978 in the San Francisco district. It has a current membership of over 8 000 teachers, organises annual conferences and encourages program exchange among its members.

HIGHER EDUCATION

The Plato project

The Plato (Programmed Learning and Teaching Operations) CAI project was launched at Illinois University's Computer-based Education Laboratory in 1960.

At the outset, its specific objectives were of two kinds:

- Research on the possible role of the computer in the teaching process;
- Development of an educationally and economically viable system on the basis of the findings of the research phase.

So the aims were both to produce materials demonstrating the possible functions of computers in the learning process and to solve the conceptual and technical problems of designing a computerised system to meet specific educational requirements at an acceptable cost.

Several versions of the system have been developed since 1960 in step with the strides made by hardware manufacturers. At the moment the system uses a mainframe computer linked by telephone line to hundreds of terminals across the country (originally radio links were used for reasons of economy). The programs are stored and run by the mainframe computer which distributes them on request to remote stations. Control Data Corporation markets the network which has about 130 stations. A special programming language was developed during the project. Its name is Tutor and most of the courseware has been written in it. At last count, there were 4 500 courses in over 70 disciplines (banking methods, mathematics, mechanical engineering, chemistry, veterinary medicine, etc.).

Early on, the producers of the system concentrated on developing low-cost but reliable hardware and software. A quality assessment run by the Educational Testing Service found no appreciable difference in terms of teaching effectiveness between Plato and conventional courses, though teachers and students both said they were satisfied with their use of Plato. In spite of these findings - less positive than had been hoped - the Plato system has been taken on by many universities. Delaware University adopted the system in 1975 and for academic year 1982-3 the figures were 94 302 student/hours for 29 976 students taking 148 different courses. The University has 20 internal and 92 off-campus terminals.

Control Data Corporation, which has invested about one billion dollars in the development of hardware and software, has authorised other microcomputer manufacturers to make or modify under licence software to suit their own hardware.

The PCDP project

This project was developed at the University of California at Irvine and has been operational for the past fifteen years. It concerns the teaching of physics at university level and uses colour graphics terminals linked to a mainframe computer, and microcomputers.

The interesting feature of this project is its approach to program design. Whereas in most cases a program author is expected to control the whole chain of production, from idea to writing the program via technical documentation, the philosophy in the PCDP is that each stage in production has to be the responsibility of the specialist best qualified. In the PCDP, educators write scenarios describing the visual content of the course and the types of interaction expected of the student at the terminal. The scenarios then go to programmers and, after going back and forth between educator and programmer to refine the product, the program is then supplied to the student. Finally, the student's reactions, recorded by the computer, enable the program to be further improved if necessary.

(Pro mem.) The TICCIT project

The TICCIT experimental CAI project was developed by Mitre Corporation at Brigham Young University. For the moment it has been shelved.

The objectives of the project were primarily:

- To humanise the teaching process (closer teacher-student relationship).
- To adapt content and methods to students' individual requirements.
- To individualise teaching and to change the role of the teacher.

The project was defined in 1970 and operated experimentally in several higher education establishments between 1973 and 1976, in particular at Phoenix Community College and Northern Viginia Community College. It used minicomputers connected to about a hundred terminals whose peculiarity was that they were standard television monitors fitted with keyboards (another of the projects aims was to test out sturdy hardware offering a low-cost alternative to the expensive systems in use in the 1970s).

The courses were produced by teams of educators at an average cost of two million dollars each. The assessment of three of them made by Educational Testing Service revealed a five per cent higher performance rate in examinations than with conventional teaching but a lower performance overall and a feeling of isolation and anonymity among the TICCIT students.

Future trends

A reasonable forecast to 1990 is that the current positive trend will continue: yet more schools will have yet more computer equipment.

The underlying attitudes among school staff and administrators are mixed. Moreover, they are determined more by beliefs and institutional context than by knowledge of problems and opportunity.

The current variation by States is also likely to continue.

Software development remains one of the key issues for the years ahead. A recent survey reveals some 700 private-sector firms engaged in educational software development, most of them small and very small. Approximately 1 650 separate software titles were found in mathematics and science education, 500 in reading and writing and 500 in foreign language instruction. With the exception of drill-and-practice software in elementary arithmetic and initial reading skills, which often parallels the school curriculum, grades K-6, the remaining titles are generally stand-alone packages that do not map onto the course syllabus. This creates new difficulties for the classroom teacher in deciding on their timely and appropriate use. There is widespread agreement that only a small number of these titles - less than five per cent - make use of the unique potential of the computer for improving student learning. Very little software development is currently supported by State and local education agencies or by agencies of the Federal Government.

Sources:

- An overview of computers in US education. In T.H.E. Journal, Vol 12, No. 1, August 1984.
- Document CERI/NT/84.02 (OECD).
- Availability and growth of microcomputers in American schools. In T.H.E. Journal, Vol 12, No. 1, August 1984.
- Computers in education and developed countries. Methods, achievements and problems (J. Hebenstreit), Unesco, Doc. ED-84/WS/10, September 1984.
- Issues in training teachers to use microcomputers in the classroom: examples from the United States (R.T. Hess and I.T. Miura). Policy paper No. 84-C2. February 1984.
- Educational software development in USA; report of a short visit (Vittorio Midoro). September 1984.

U R U G U A Y

Basic data

Total school population: 601 466

Education budget: 2 958 337 000 new Pesos (1981)
as percentage of GNP: 2.4%

Structure of educational system: Not available.

	School population per level	Number of teachers per level
Primary	363 179 (1982)	16 821 (1982)
Secondary	190 053 (")	
Tertiary	48 234 (")	4 149 (1981)

SECONDARY EDUCATION

Computer literacy/computer science - the ALFA project

The "mother" institution in which the ALFA project was developed is the Union Mondiale ORT, an international non-profit network whose purpose is to promote educational research and the teaching of technical subjects.

The project is under the supervision of the ORT Technological Institute of Uruguay, the country's biggest technical training institute with 2 000 students. Also involved are 5 private secondary schools in Montevideo and two private ssuppliers of hardware and finance (IBM-Uruguay and Olivetti-Uruguay). The central hub of the network (ORT) is responsible for coordination, research and publications and for program development, validation and distribution.

Offshoots in the schools concerned run the computer laboratory and provide instruction. The laboratory operates as a general service for the teaching of all disciplines.

The essence of the network's teaching activity, however, centres on the development of computer literacy and the teaching of computer science. This extends over the whole span of secondary education, beginning with Logo and Prolog, computer technology and Pascal and finally preparation for the tertiary cycle with the learning of Basic, Fortran and fourth generation languages.

In 1984, the project reached 900 pupils; the intention is to extend it to the pre-school, primary and adult education levels.

Source: Informática y educación. Simposio internacional. 30 April/4 May 1984. San Miguel de Tucumán, Argentina, 1985.

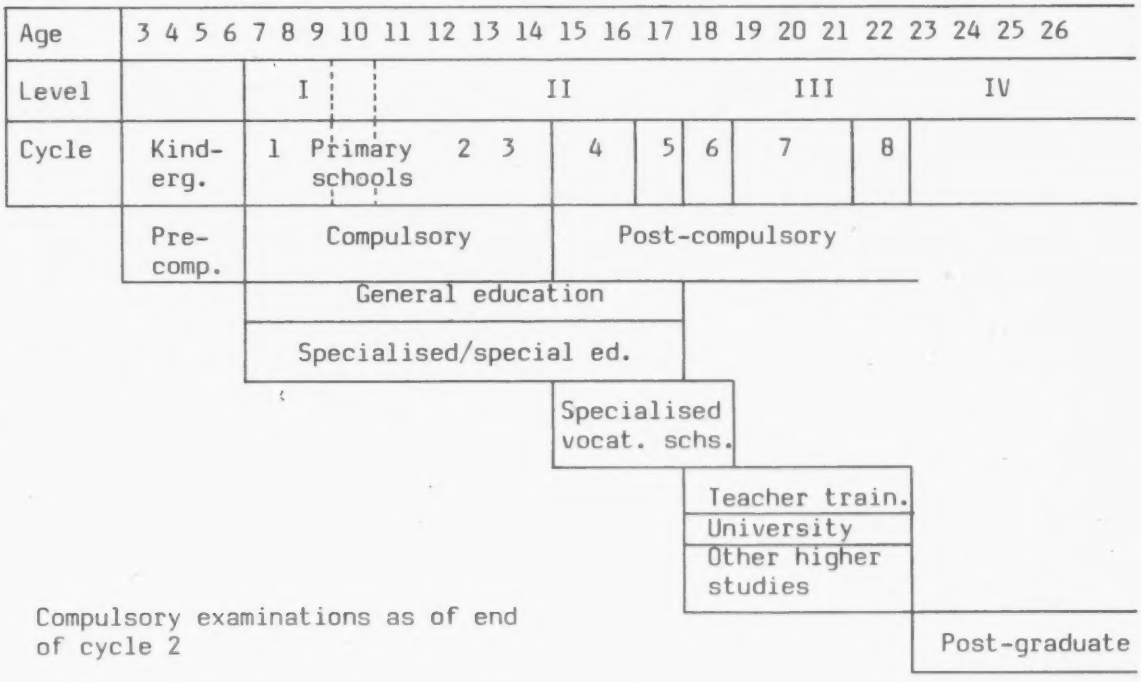
U S S R

Basic data

Total school population: 47 644 200

Education budget: 35 323 300 Roubles (1982)
as percentage of GNP: 6.7%

Structure of educational system:



	School population per level	Number of teachers per level
Primary	22 660 000 (1982)	2 338 000 (1982)
Secondary	19 669 000 (")	
Tertiary	5 315 200 (")	375 600 (1982)

PROJECT POLICY

At a meeting in 1969 the Council for Mutual Economic Assistance decided to coordinate the production and use of computer hardware in Member countries. Later it decided to coordinate educational policies and vocational training in the area of informatics.

In 1985 reforms were put into effect in secondary education in the USSR, a central feature of which concerned the introduction of computers, hinged onto an overall project entitled "Continuous training in informatics" the object of which was to enable all pupils to:

- know how to use algorithms,
- know how to programme in practical terms
- know how to use computers for practical tasks, and
- know the rudiments of microprocessor and computer technology.

The measures taken with regard to informatics phase the learning process from the first year in secondary to the end of higher education, each phase coresponding to the acquisition of particular skills, generally tested by means of a special examination.

Curricula have been re-arranged (with informatics introduced as a subject) and the content of mathematics and physics courses revised.

SECONDARY EDUCATION

Hardware

Schools are to be equipped with microcomputers (ELEKTRONIKA and ISKRA series, K-0010, AGAT and TIMUR home microcomputers). Generally they are grouped together in computer rooms, one per school and containing 4-6 machines.

Applications

Teaching of informatics

This is organised in three stages in secondary education:

stage 1: children aged 10 to 13
stage 2: " " 13 to 15
stage 3: " " 15 to 17.

The first two stages represent basic training and the third specialised training leading on to what is taught in technical and vocational schools and university courses.

Teacher training

Special courses for teachers in vocational and technical schools were organised in the summer of 1985 to enable them to teach the new subjects in the curriculum.

At the same time, teacher training courses (at educational centres and university) were changed. A new qualification (mathematics and information technologies) has been set in place for teachers responsible for teaching informatics.

The intention in the medium term is to develop further training facilities for practising teachers by installing computer laboratories in certain towns and organising special courses at university and in educational and technological institutes.

HIGHER EDUCATION

In higher education, applications largely concern CAI, simulation and games programs in economics and engineering science and monitoring the learning process (tests).

In particular, the Moscow Electronics Institute has developed two systems:

- The AKKORD system for monitoring learning in all the subjects taught at the higher level.
- The ASTRA system which combines computer assisted instruction and performance monitoring.

VENEZUELA

Basic data

Total school population: 3 825 057

Education budget: 17 018 635 000 Bolivars (1981)
as percentage of GNP: 5.8%

Structure of educational system:

Age	3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
Level	I II III IV
Cycle	1 2 3 4 5 6

Pre-comp. | Compulsory | Post-compulsory

Intermediate

Teacher train. Techn.

Univers. college

University institutes Military schools

University

Higher education

Compulsory examinations at end of cycles 1 and 3 to 6.

	School population per level	Number of teachers per level
Primary	2 591 051 (1981)	97 045 (1981)
Secondary	884 233 (")	39 876 (1975)
Tertiary	349 773 (1982)	28 892 (1982)

Venezuela is currently engaged in formulating a national policy on computers in education and a national plan of action in this field. The proposals of the exploratory mission include:

- The creation of a Commission at the Ministry of Education bringing together representatives of the Directorates for Planning, Informatics, International Relations and the General Coordination of Programmes for the Development of the Intellect.

- The creation of an interdisciplinary team of university teachers to devise and launch pilot projects for the introduction of informatics in the educational system.

- The definition of a work plan for the design of pilot operations which would focus on algorithmic and heuristic strategies in problem-solving, learning languages, logical programming, the use of services (word processing, drawing, electronic pallets, databases, etc.) simulation programs, the development of Logo activities and lastly the use of the computer as an aid to learning (CAI).

- The evaluation of the pilot projects in order to refine policies, re-focus the development plan and generalise its recommendations.

- The definition and implementation of a teacher training strategy.

Source: Informática y educación. Un documento de trabajo preparado para el Ministério de Educación de Venezuela (Dr. Fidel Oteiza M. Consultor) Caracas, Aug. 1985.